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OBJECTIVES

The University Aviation Association publishes the Collegiate Aviation Review International throughout each calendar year. Papers published in each volume and issue are selected from submissions that were subjected to a double-blind peer review process.

The University Aviation Association is the only professional organization representing all levels of the non-engineering/technology element in collegiate aviation education and research. Working through its officers, trustees, committees, and professional staff, the University Aviation Association plays a vital role in collegiate aviation and in the aerospace industry. The University Aviation Association accomplishes its goals through a number of objectives:

- To encourage and promote the attainment of the highest standards in aviation education at the college level
- To provide a means of developing a cadre of aviation experts who make themselves available for such activities as consultation, aviation program evaluation, speaking assignment, and other professional contributions that stimulate and develop aviation education
- To furnish an international vehicle for the dissemination of knowledge relative to aviation among institutions of higher learning and governmental and industrial organizations in the aviation/aerospace field
- To foster the interchange of information among institutions that offer non-engineering oriented aviation programs including business technology, transportation, and education
- To actively support aviation/aerospace oriented teacher education with particular emphasis on the presentation of educational workshops and the development of educational materials covering all disciplines within the aviation and aerospace field

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02-27-2024

Exploring Collegiate Flight Training Students' Perceptions of Safety Culture

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As flight training organizations expand and adapt to meet the growing demands of the industry, organizational leadership and safety departments are continuing to intensively focus on aviation safety and quality assurance through the core values of safety promotion, culture, and education. A flight school's safety culture, shaped by students' risk perceptions, can predict safety behaviors. Understanding students' trust and confidence in this safety culture could potentially aid in early risk mitigation strategies. The purpose of this study was to investigate flight students' perceived safety culture at a Title 14 Code of Federal Regulations (CFR) Part 141 flight training school in the Southeast region of the United States. The survey was adapted from the Safety Culture Indicator Scale Measurement System. Quantitative and qualitative data were obtained from 398 students. Confirmatory factor analysis and structural equation modeling were used to test structural relationships among organizational commitment, operations interactions, formal safety indicators, and safety behaviors. Results indicated a good model fit to analyze the nine hypotheses. Two of the nine hypotheses were supported. Safety Values and Safety Personnel significantly influence perceived personal risk. The textual data analysis revealed strong student's opinions towards a medical grounding and no-show procedure initiated by the Flight Department. Additionally, themes identified students' desire to receive more communication of safety information and the language barriers present in a multi-cultural operation.

Recommended Citation:
Anderson, C., Lee, S., Mendonca, F. A.C., Misra, S., & Byrnes, K. (2024). Exploring collegiate flight training students' perceptions of safety culture. *Collegiate Aviation Review International*, *42*(1), 1–28. Retrieved from https://ojs.library.okstate.edu/osu/index.php/CARI/article/view/9683/8591

Introduction

An Alaska Department of Public Safety (DPS) helicopter encountered a snowstorm and poor visibility while attempting to rescue a stranded snowmobiler in Alaska, ultimately resulting in a crash (National Transportation Safety Board [NTSB], 2014). The NTSB identified an unhealthy safety culture within the DPS as one of the contributing factors to the mishap. According to the Agency, the Alaska DPS had a "punitive safety culture that impeded the free flow of safety-related information and impaired the organization's ability to address underlying safety deficiencies relevant to this accident" (p. viii). The term safety culture first appeared during the investigation of the Chernobyl disaster in 1986. Organizational pressures, program shortcomings, and a flawed safety culture were also causal factors of the Space Shuttle Columbia disaster in 2003 (National Aeronautics and Space Administration [NASA], 2003). Safety culture is a multi-dimensional construct and includes an informed culture, a reporting vulture, a just culture, a flexible culture, and a learning culture (Reason, 1998).

> Safety culture refers to the enduring value, priority, and commitment placed on safety by every individual and every group at every level of the organization. Safety culture reflects the individual, group and organizational attitudes, norms and behaviors related to the safe provision of air navigation services (Civil Air Navigation Services Organization, 2008, p. 1).

Until the early 1970s, accident investigators and researchers focused on weather conditions, technological failures, and especially human errors as root causes of accidents. However, aviation professionals began to recognize that errors and violations are often triggered by organizational factors such as organizational climate, safety culture, safety oversight, safety values and beliefs, and safety programs. Aircraft accidents and incidents are typically the result of multiple contributing factors, with frontline personnel's unsafe acts (e.g., pilots) often influenced by organizational factors and latent conditions (Shappel et al., 2007).

Effective safety management requires much more than just a safety office and safety standards and procedures. According to Ayres Jr. et al. (2009), Safety Management Systems (or any safety program) are most effective in organizations with a strong safety culture. A strong safety culture is difficult to quantify. Nonetheless, in an organization with a healthy safety culture, personnel are proactive and understand that they are responsible and accountable for the safety of their organization. Moreover, employees truly understand the risks associated with their jobs and take action to mitigate those risks. Additionally, they strongly believe that safety should not have to come at the cost of productivity. Most importantly, safety is an integral part of the education and training personnel receive so that they have the knowledge and skills to work safely and effectively (Ayres Jr. et al., 2009).

There is an inherent risk associated with flight training in a collegiate aviation environment (Byrnes et al., 2022). Organizational factors such as the organization's safety climate and safety culture play significant roles in the safety efforts in such a system. Previous studies have suggested that organizations with a healthy safety culture are less prone to experiencing safety-related events. Thus, it is important to better understand the safety culture of students in a Part 141 college flight program. Findings can provide Part 141 flight training schools with data and information to develop or enhance their safety management systems.

Literature Review

Previous studies have attempted to assess the safety culture of flight training organizations. Freiwald et al. (2013) utilized a mixed-method approach to investigate the operations and management staff in a flight training organization, finding a lack of familiarity with the safety reporting system and a deficient accountability system in the organization safety program. As previously noted, professionals with a strong safety culture are responsible and accountable for the safety of their organization. Adjekum (2014) assessed the students' perception on the status of the safety program of an accredited Part 141 four-year collegiate aviation program. Findings suggested that there were significant differences in the perception of the program's safety culture by students based on their national cultures. Power distance, uncertainty avoidance, masculinity vs. femininity, and individualism vs. collectivism are cultural dimensions displayed in a society's rituals and values (Hofstede, 2001). Keller et al. (2015) investigated cultural dimensions between US. Collegiate aviation and Chinese students. A survey questionnaire was distributed electronically to US students and in a paper format to Chinese students at a Chinese university. Findings suggested that relationships between subordinates and superiors (power distance) in China are more unequal than in the US. Similarly, "Chinese aviation students indicated a larger gap between the equality of men and women" (p. 13). The authors concluded that the findings of their study could be used during the development of education policies and other strategies to improve retention, as well as to foster a more effective learning environment. Adjekum et al. (2016) examined the relationship between safety culture perceptions and safety reporting behavior of non-flight students from five Part 141 collegiate flight programs located in the midwestern and southwestern parts of the U.S. Results suggested that inadequate feedback from safety personnel regarding submitted safety reports by non-flight students may reduce the students' interest in reporting safety hazards. Findings also suggested that older and relatively more mature non-flight students may be less willing to report safety hazards. Gao and Rajendran (2017) assessed the safety culture of an Australian collegiate flight program using a self-constructed survey questionnaire. Findings suggested participants had confidence in their organization's safety reporting system but also indicated a perceived distance between students and senior management on the organization's safety culture.

Wheeler et al. (2019) investigated the safety culture of a collegiate flight school in the Southeast of the U.S. Participants were recruited from flight operations and included maintenance personnel and flight students taking core aeronautical courses. The results indicated a positive safety culture across all groups in the flight program. Byrnes et al. (2022) investigated the impact of the COVID-19 pandemic on the safety culture and safety climate of a Part 141 collegiate flight training organization. Researchers utilized longitudinal data from 2018 through 2021. Findings suggested that the safety culture (e.g., effective communications) and safety climate (e.g., personal safety responsibility) constructs were impacted during the COVID-19 pandemic. Silcox et al. (2022) investigated the impact of organizational culture on the safety of a school of aviation science's flight training operations. Participants in this study included members of the flight line services, aircraft maintenance, records, scheduling, dispatch services, flight instruction, and active flight students within Utah Valley University. Researchers identified areas for improvement in the safety culture of the organization, and they included effective communications between key stakeholders and enhanced safety training and education.

Aircraft reliability, as well as aviators' education and training, have significantly improved over the last decades. Nonetheless, aircraft accidents, incidents, and near misses still occur due to organizational and other human factors (Mendonca et al., 2021). Human errors and violations often indicate latent conditions in the aviation system. A robust safety culture will not guarantee there will be no aircraft mishaps resulting from organizational factors. Notwithstanding, it will significantly mitigate the risk of aircraft accidents during flight training. In the past, the pilot pipeline was massively provided by the military in the U.S. The significant shortage of pilots (Department of Defense, 2017) has increased demand for collegiate aviation, which is now the primary pipeline for producing professional pilots. Therefore, there is an imperative need to better understand the safety culture of pilots in a Part 141 collegiate aviation environment. Findings from this study can provide a scientific basis for regulatory decisions, academic policies, and enhanced flight training and education. Most importantly, this study provides an opportunity to close gaps in identified literature and advance safety culture research in aviation.

Methodology

Survey Framework

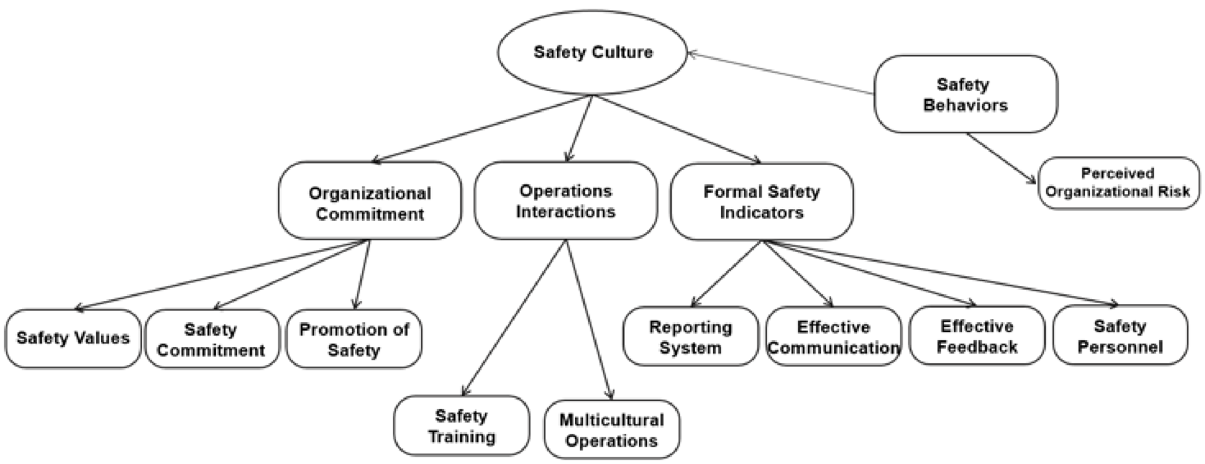
The purpose of the study was to investigate flight students' safety culture at a Title 14 Code of Federal Regulations (CFR) Part 141 flight training school in the Southeast region of the United States. A survey was conducted to determine the relevant factors influencing flight students' perception of the organization's safety culture. The quantitative results of the survey were then analyzed using Structural Equation Model (SEM) techniques. SEM in the form of a relational path model was used to test hypotheses postulated about predictive relationships between the factors and the dimension of safety culture. It was also used to determine the strength of relationships between these factors and the dimension of safety culture. Additionally, researchers generated a Word Cloud from the limited qualitative data, as explained in the results section of this manuscript.

The questions selected for use in the survey were drawn from the Safety Culture Indicator Scale Measurement System (SCISMS), originally based on the Commercial Aviation Safety Survey (CASS). CASS has been implemented by numerous studies in the past decade, demonstrating its utility as a measure of organizational safety culture in aviation operations (Adjekum, 2014; Alsowayigh, 2014; Freiwald et al., 2013; Gibbons et al., 2006; McNeely, 2012; O'Leary, 2016). SCISMS uses a robust four-factor model designed to correlate organizational commitment, formal safety indicators, operations interactions, and informal safety indicators with personal safety attributes (Von Thaden & Gibbons, 2008). The SCISMS produces outcomes on two scales: Perceived Personal Risk/Safety Behavior and Perceived Organizational Risk intended to reflect students' perceptions of safety, thus reflecting the safety climate of the organization. The SCISMS is designed only to capture students' perceptions of risk and does not reflect an objective measurement of safety behavior or risk (Von Thaden & Gibbons, 2008).

Factors affecting students' perceived safety culture were divided into second-order factors, including organizational commitment, operations interactions, and formal safety indicators. Second-order observed variables were then developed. The originally suggested observed variables from the CASS Operations Interactions (supervisors/foremen, operations control/ancillary operations, chief/fleet pilots, dispatch, operations control, ground handling/ramp operations, maintenance/engineering, and cabin crew) were removed from the framework due to their irrelevant application to collegiate flight students directly. These variables were more appropriate for assessing safety culture in instructors rather than flight students. However, Multicultural Operations were added to account for the multicultural climate at this Title 14 CFR Part 141 flight training school in the Southeast United States.

Additionally, some observed variables from the Informal Safety Indicators (accountability, employee authority, and professionalism) were also removed due to their irrelevance to this particular study. Finally, Response and Feedback from the original CASS were divided into effective communication and effective feedback. Figure 1 shows the modified framework used for this study.

Figure 1
Modified Safety Culture Framework



The survey included two open-ended questions allowing respondents to provide suggestions and comments (see below). The open-ended questions were optional and not mandatory to successfully complete the survey.

1. Please describe any additional comments you have regarding safety in the Flight Department.
2. Please describe any recommendations for improving safety in the Flight Department.

Survey Distribution

After Institutional Review Board (IRB) approval was obtained, purposeful sampling was used to target the population of interest. The survey was administered through Microsoft Forms in the English language to allow for simplicity of delivery and anonymity of participants. Participants were assured of the confidentiality of their responses. The survey was open for two weeks.

Hypotheses

The following hypotheses were investigated in the study:

H_1: Safety values significantly influence perceived organizational risk
H_2: Promotion of safety significantly influences perceived organizational risk
H_3: Safety commitment significantly influences perceived organizational risk
H_4: Reporting system significantly influences perceived organizational risk
H_5: Effective communication significantly influences perceived organizational risk
H_6: Effective feedback significantly influences perceived organizational risk
H_7: Safety personnel significantly influences perceived organizational risk
H_8: Safety training significantly influences perceived organizational risk
H_9: Multicultural operations significantly influence perceived organizational risk

Please see Appendix A for information about the questions used in the survey questionnaire to capture each one of these constructs (e.g., safety values).

Population

The population of interest consisted of 1,501 active flight students at a large, accredited Title 14 CFR Part 141 flight training and four-year degree-awarding university in the Southeast regions of the United States (FAA, 2017). The sample (n = 398) was drawn from active flight students accounting for approximately 27% of the population.

Results

Demographics

Demographic information such as gender, age, enrollment status, and international status was collected during the survey. Table 1 shows the demographics of the sample (n=398). Almost 24% of the respondents were international students. Fifty–eight of these students were juniors or seniors. Interestingly, most respondents (80.9%) had not filed a safety report before.

Among all the respondents, 82.2% were men, 17.1% were women, and 0.8% preferred not to say. The gender ratio disbursement of the sample was representative of the population demographics, which has a male-female ratio of 83.3% to 16.7%. Most respondents were domestic students (76.6%). This was also representative of the population with a 77.7% domestic student population.

Table 1
Demographic Variables

Characteristics	Subgroup Categories	Frequency	Percentage
International	International	93	23.4%
	Domestic	305	76.6%
		398	100%
Private Pilot License	Internally earned	169	42.5%
	Earned elsewhere	144	36.2%
	No License received	85	21.4%
		398	100%
Flight Certifications	Student Pilot	91	22.9%
	Private	94	23.6%
	Instrument	104	26.1%
	Commercial-Single	56	14.1%
	Commercial-Multi	16	4.0%
	CFI	16	4.0%
	CFI-I	20	5.0%
	Multi Instructor	1	0.3%
		398	100%
Enrollment	Freshman	93	23.4%
	Sophomore	68	17.1%
	Junior	113	28.4%
	Senior	117	29.4%
	Graduate	7	1.8%
		398	100%
Age	Below 20	128	32.2%
	20-25	249	62.6%
	26-30	16	4.0%
	31-35	2	0.5%
	36-40	2	0.5%
	41-45	0	0%
	46-50	1	0.3%
	Above 50	0	0%
		398	100%
Gender	Male	327	82.2%
	Female	68	17.1%
	Prefer not to say	3	0.8%
		398	100%

Table 1 (*continued)*

Characteristics	Reports Submitted	Frequency	Percentage
Safety Report	0	322	80.9%
	1	52	13.1%
	2	13	3.3%
	3	6	1.5%
	4	4	1.0%
	5	1	0.3%
		398	100%

Analysis of the Responses to the Safety Culture Questionnaire

The current study examined the impact of nine factors – safety values (SV), promotion of safety (PS), safety commitment (SC), reporting system (RS), effective communication (EC), effective feedback (EF), safety personnel (SP), safety training (ST), and multicultural operations (MP) – on perceived organizational risk (SR). In the survey questionnaire, each factor was measured by three- to five-item questions. The respondents were asked to evaluate these items based on a 5-point Likert scale, from 1 (strongly disagree) to 5 (strongly agree). Table 2 shows the values of the mean and standard deviation of the scale items. Figure 2 shows the final specified CFA model, and Figure 3 shows the final specified SEM model.

The sample mean (M) is the average of the observations, and SD indicates the dispersion of individual observations about M. Both the sample mean and standard deviation play important roles, particularly in the context of model fit evaluation and parameter estimation. When the observations are more dispersed, then there will be more variability. In this case, a relatively low SD signifies less variability of data.

Table 2
Mean and Standard Deviation Scores of Constructs

Construct		*M*	*SD*
Safety Values	SV1	4.37	0.816
	SV2	3.54	1.066
	SV3	4.26	0.779
	SV4	4.19	0.865
	SV5	3.90	1.138
Promotion of Safety	PS1	4.09	0.785
	PS2	4.08	0.805
	PS3	4.42	0.723
	PS4	4.40	0.780
	PS5	4.48	0.683
Safety Commitment	SC1	4.21	0.745
	SC2	4.27	0.746
	SC3	3.46	1.176
	SC4	4.15	0.806
Reporting System	RS1	3.71	0.845
	RS2	3.82	0.959
	RS3	4.07	0.766
	RS4	4.07	0.819
Effective Communication	EC1	3.80	0.957
	EC2	3.90	0.884
	EC3	3.97	0.841
	EC4	3.88	0.927
Effective Feedback	EF1	3.79	0.794
	EF2	3.84	0.805
	EF3	3.82	0.817
	EF4	3.39	1.114
Safety Personnel	SP1	4.04	0.810
	SP2	4.07	0.731
	SP3	4.16	0.755
	SP4	4.16	0.724
Safety Training	ST1	4.20	0.801
	ST2	4.10	0.924
	ST3	4.25	0.757
	ST4	4.36	0.698
Multicultural Operations	MO1	3.49	1.153
	MO2	4.00	0.946
	MO3	3.73	1.152
Safety Behaviors	SR1	3.27	1.163
	SR2	2.90	1.197
	SR3	3.51	1.133

Figure 2

The Final Specified CFA Model

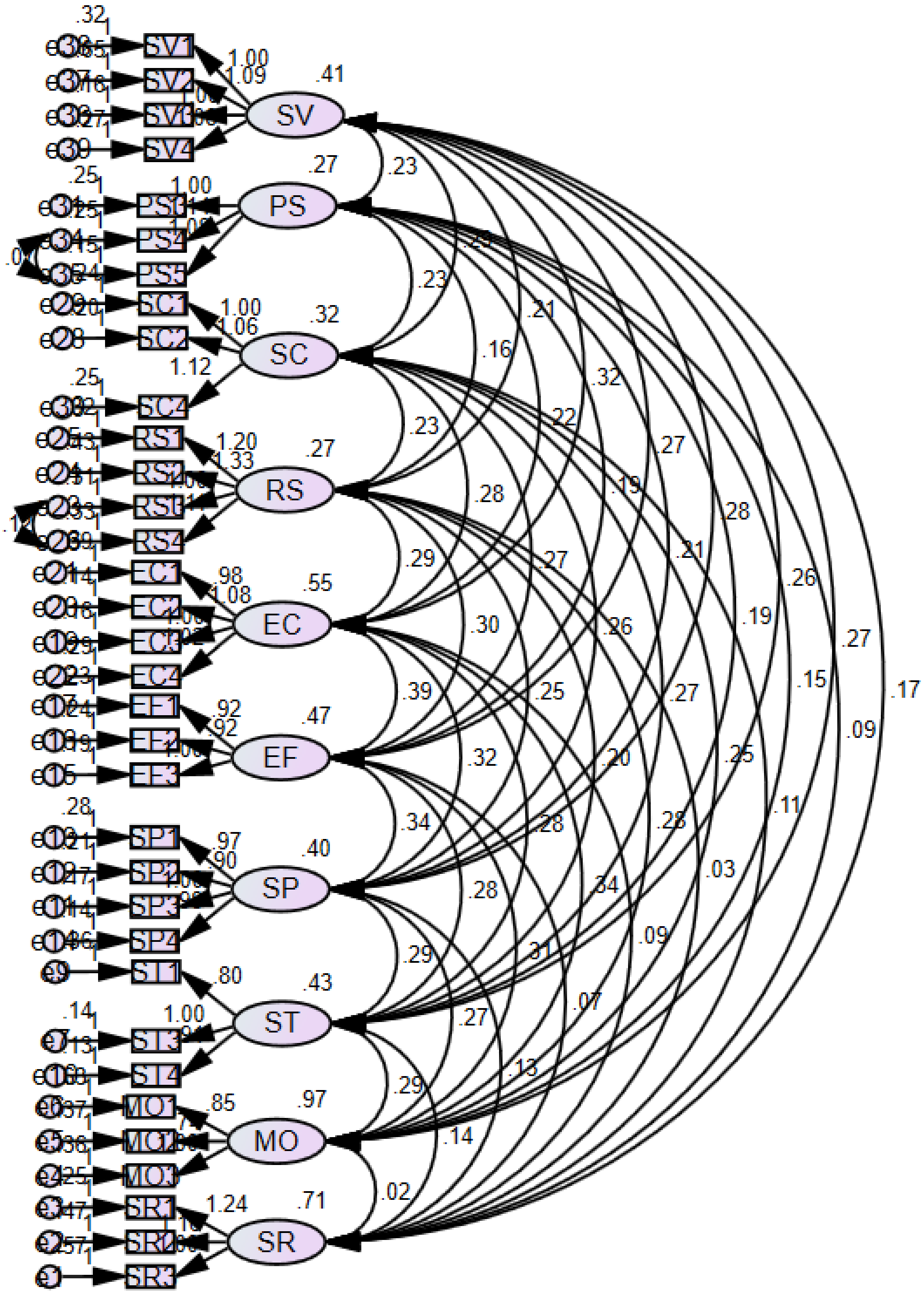
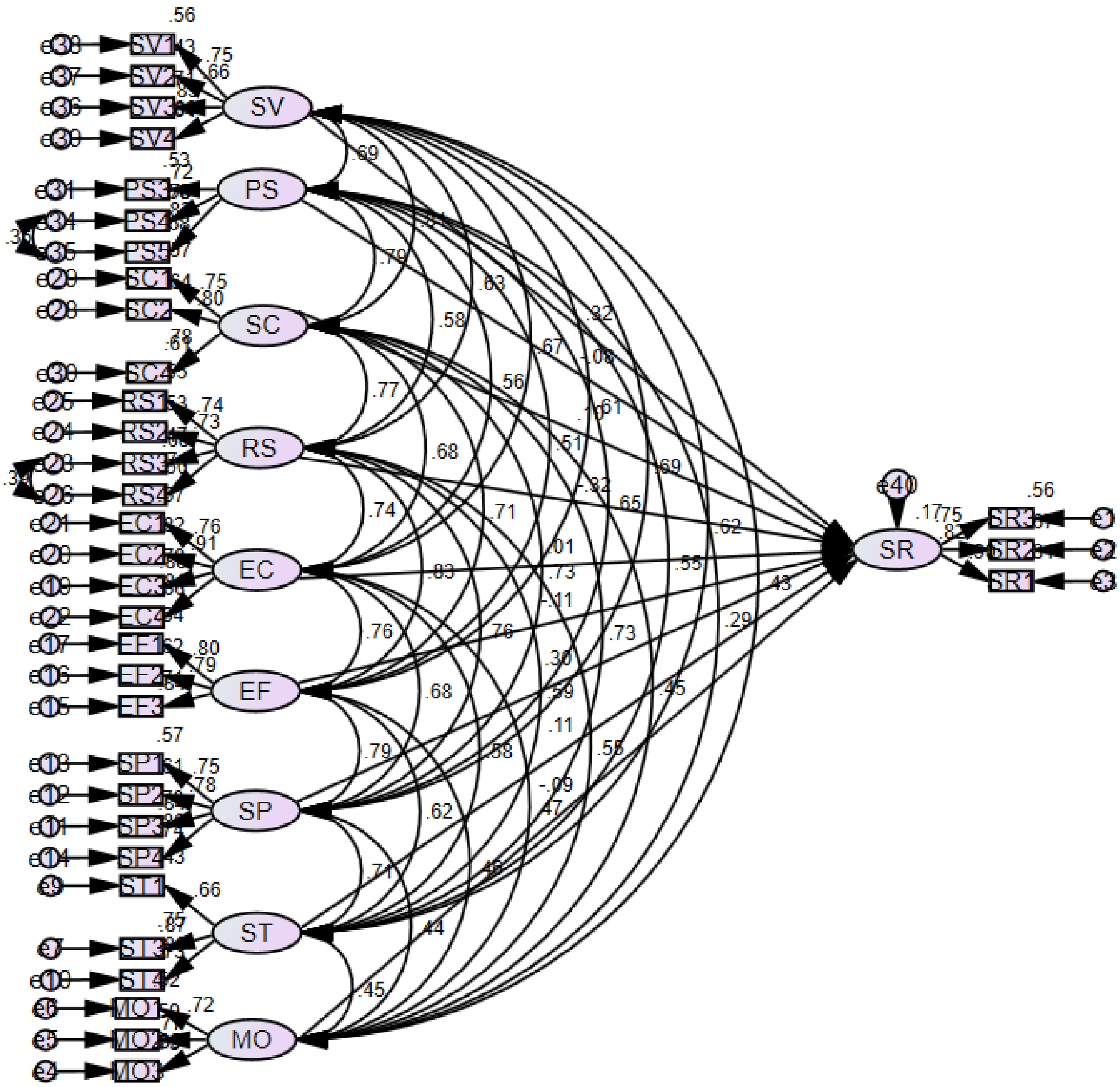


Figure 3
The Final Specified SEM Model



Convergent validity and discriminant validity were examined for the final specified CFA model. PS1, PS2, SC3, EF4, and ST2 items were removed from the initial specified CFA model for reliability and validity. Four indicators of convergent validity were evaluated, including factor loadings, Construct Reliability (CR), Average Variance Extracted (AVE), and Maximum Shared Variance (MSV). The acceptance value for factor loading was ≥ .65, CR was ≥ .70, Cronbach's alpha was ≥ .70, and AVE was ≥ .50 (Hair et al., 2010; Vogt et al., 2012). All the standardized factor loadings passed the .65 threshold, and the CR and Cronbach's alpha were greater than .70, indicating satisfactory consistency among items. AVE values for all factors were greater than .05, indicating satisfactory convergent validity. Table 3 shows the results of the convergent validity assessment for the final CFA model.

Table 3
Convergent Validity Assessment of the Final CFA Model

Construct	Item	Factor Loading	Squared multiple correlations	CR	Cronbach's alpha	AVE
SV	SV1	.75	.56	.78	.83	.59
	SV2	.66	.44			
	SV3	.85	.72			
	SV4	.80	.64			
PS	PS3	.73	.53	.82	.84	.60
	PS4	.76	.58			
	PS5	.83	.69			
SC	SC1	.75	.56	.82	.82	.60
	SC2	.80	.64			
	SC4	.78	.61			
RS	RS1	.74	.55	.81	.82	.51
	RS2	.73	.53			
	RS3	.68	.46			
	RS4	.71	.50			
EC	EC1	.76	.58	.91	.90	.71
	EC2	.91	.83			
	EC3	.88	.77			
	EC4	.81	.66			
EF	EF1	.80	.64	.85	.85	.66
	EF2	.79	.62			
	EF3	.84	.71			
SP	SP1	.75	.56	.88	.88	.65
	SP2	.78	.61			
	SP3	.84	.71			
	SP4	.86	.74			
ST	ST1	.66	.44	.84	.83	.64
	ST3	.87	.76			
	ST4	.86	.74			
MO	MO1	.72	.52	.82	.82	.61
	MO2	.77	.59			
	MO3	.85	.72			
SR	SR1	.90	.81	.87	.86	.68
	SR2	.82	.67			
	SR3	.75	.56			

Note. CR = Construct Reliability, AVE = Average Variance Extracted

Discriminant validity was tested by using the Fornell-Larcker method, which compared the AVE values to the correlation estimates between the constructs, as shown in Table 4. If the square root of AVE is greater than the correlation estimates, the discriminant validity is supported (Zait & Bertea, 2011). Table 4 shows the discriminant validity values. Discriminant validity showed large values for four correlations. However, the correlation between SC and SV, and SC and PS can be explained by the framework in Figure 1. All three variables are the second factors of organizational commitment. Additionally, the correlation between RS and EF, and RS and SP can also be explained by the framework. RS, EF, and SP are the second-factor variables of formal safety indicators.

Table 4
Discriminant Validity Values

	SV	**PS**	**SC**	**RS**	**EC**	**EF**	**SP**	**ST**	**MO**	**SR**
SV	**.768**									
PS	.688	**.775**								
SC	**<u>.808</u>**	**<u>.788</u>**	**.775**							
RS	.634	.583	.769	**.714**						
EC	.674	.564	.684	.739	**.843**					
EF	.607	.515	.712	**<u>.828</u>**	.765	**.812**				
SP	.687	.650	.732	**<u>.761</u>**	.680	.786	**.806**			
ST	.617	.549	.733	.585	.581	.615	.713	**.800**		
MO	.435	.290	.447	.547	.473	.465	.440	.454	**.781**	
SR	.313	.207	.233	.068	.150	.115	.253	.257	.027	**.825**

Structural Model Assessment

The final CFA model in Figure 1 was transformed into a SEM model, as shown in Figure 2. The endogenous variable was perceived personal risk. The data was then assessed for normality and outliers. All kurtosis values were less than 5.00, and squared Mahalanobis values were less than 65. Two error covariances were created between error terms from the largest MI values.

Overall Model Fit

The same acceptance value was used to analyze the model fit. Two pairs of covariances were added between the largest values of error terms. The revised SEM model indicated an acceptable model fit, as shown in Table 5. The Goodness of Fit (GFI) is the proportion of variance accounted for by the estimated population covariance (Hair et al., 2010). The GFI value was slightly off the acceptance value but tolerable (Hu & Bentler, 1999). Hu and Bentler (1999) supported that although a GFI value larger than .90 is recommended, larger than .80 may be used with caution.

Table 5
Model Fit Indices for the Final CFA Model

Model Fit Index	Acceptance Value	Final Model
X^2	-	853.324
df	-	481
Probability	>.05	***
GFI	>.90	.888
NFI	>.90	.906
CFI	>.95	.956
CMIN/df	≤ 3.00	1.774
RMSEA	<.06	.044

Note. *** significant at $p < .001$. GFI = Goodness of Fit Index, NFI = Normed-Fit Index, CFI = Comparative Fit Index, RMSEA = Root Mean Square Error of Approximation.

Following the model estimation, hypotheses were tested. Figure 4 illustrates the standardized regression weights for the SEM model. Table 6 shows the standardized path coefficients and *t*-values for the SEM model. Hypotheses with *p*-values less than .05 were supported. H_1 and H_7 had path estimates that were statistically significant in the expected direction, indicating that safety value and safety personnel were significantly correlated with perceived personal risk.

Figure 4
Standardized Regression Weights for the SEM Model

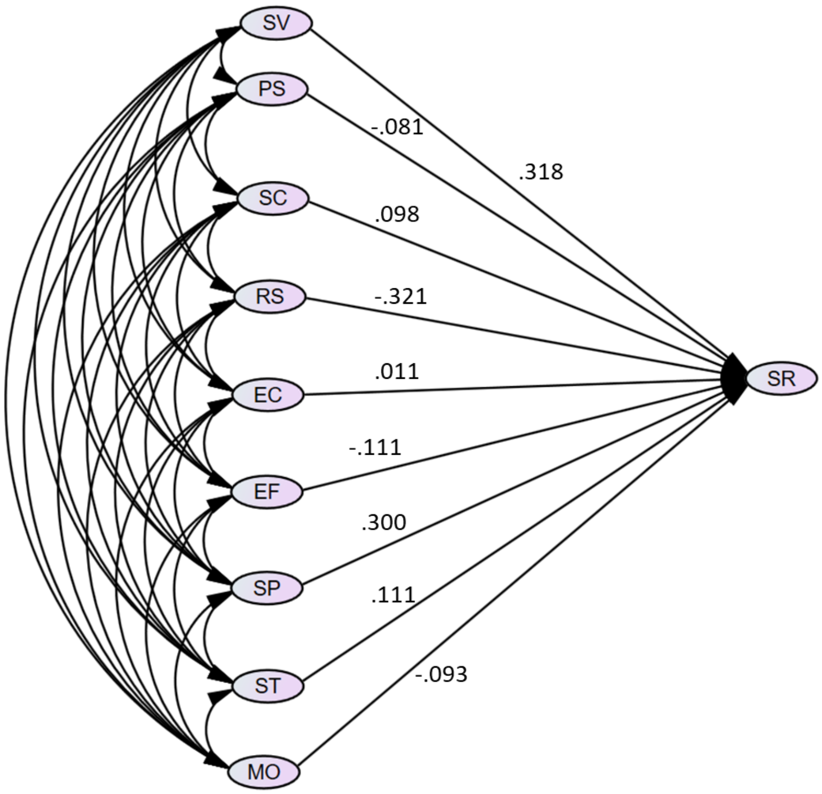


Table 6
Hypothesis Testing Results

Hypotheses	Relationships	SRW	*t*-values	*p*-values	Result
H_1	SV → SR	0.318	2.402	.016	Supported
H_2	PS → SR	-0.081	-0.595	.552	NS
H_3	SC → SR	0.098	0.409	.683	NS
H_4	RS → SR	-0.321	-1.706	.088	NS (Close)
H_5	EC → SR	0.011	0.102	.919	NS
H_6	EF →SR	-0.111	-0.682	.495	NS
H_7	SP → SR	0.300	2.011	.044	Supported
H_8	ST → SR	0.111	0.945	.345	NS
H_9	MO → SR	-0.093	-1.216	.224	NS

Note. SRW = Standardized Regression Weights, NS = Not Supported, SR was reverse-coded so the direction of the SRW and *t*-values should be opposite.

Analysis of the Qualitative Data

As previously noted, the survey included two open-ended questions, allowing respondents to provide invaluable qualitative information. While not all respondents provided an open-ended response, 162 comments were received for textual analysis. The original goal of the researchers was to conduct a sentiment analysis based on the comments and the results of the survey. However, with the limited number of open-ended responses, the study was limited to only a descriptive and qualitative analysis of the textual data. The textual data was then analyzed utilizing various libraries and functions of the Python Programming Language. Firstly, all punctuation from the data was removed to improve processing. Additionally, all the words were reduced to lowercase to maintain consistency and further tokenized into individual features. Stopwords were removed from the textual data to eliminate superfluous words that had a minimal contribution to the textual analysis. Finally, the textual data was lemmatized to improve the comprehensibility of the data. Lemmatization is a process where words are reduced to a root word, such as the word *better* would be reduced to the word *good*. Lemmatization was preferred over stemming due to improved accuracy and domain understanding of the subject.

Once the textual data was processed, a Word Cloud was developed. Based on the initial Word Cloud, the researchers added more stopwords to reduce superfluous words from the generated Word Cloud. Words such as “against”, “other”, “or”, “reason”, listed”, “student”, “safety”, “flight”, “department”, and “feel” were added to the stop words list. Figure 5 was the generated Word Cloud from the textual data. Table 7 displays the frequency and relative frequency of words with a relative frequency of more than 0.5.

Figure 5
Word Cloud from Textual Data

Table 7
Frequency of Words in the Textual Data

Word	Frequency	Relative Frequency
Fatigue	33	1.0
Ground	30	0.909
Sick	19	0.576
No-Show	18	0.545
Training	18	0.545

Note. The word "Ground" refers to the grounding policy for students. Only words with a relative frequency of more than 0.50 and not included in the stop words are included in this table.

Qualitative Analysis for Perceived Risks

A qualitative analysis was conducted to capture relevant and recurring themes in the data. Phenomenological reduction, bracketing, and composite textual and structural description procedures were applied for qualitative analysis. The researchers read the comments and manually coded sentiments to identify themes. Three significant themes regarding perceived safety risks were captured from the data.

Medical Grounding and No-Show Policy

The Medical Grounding and No Show Policy was the most recurring theme in the textual data. Respondents had a negative sentiment regarding a recently implemented policy. The "No

Show Policy" changes were reviewed using the SMS risk assessment process, and no increase in risk severity and probability was found. Nonetheless, we recommend further studies on the impact of this "No Show Policy" on flight students' perceptions of safety culture.

Information Sharing and Communication

Information sharing and communication was theme evaluated in 13 comments. The findings supported that some students feel that communication regarding safety incidents and accidents could be improved. Effective safety communication is vital for a sound safety culture. "The free exchange of safety information, across all areas and through all levels, both vertically and horizontally, is actively promoted by management and facilitated by mechanisms and processes" (Ayres Jr. et al., 2009, p. 156).

Multi-cultural Operations.

Multi-cultural operations was a theme evaluated in four comments. The findings supported that some students feel that a language barrier due to a multi-cultural environment could affect their perceptions of safety as suggested by the International Civil Aviation Organization (ICAO, 2002). Part 141 flight training organizations are increasingly and steadily becoming multicultural. Individuals from different nations may be paired in the cockpit, and language barriers may disrupt effective communication.

Thematic Analysis

The qualitative data analytics procedures described in this paper were intended to gather better insight into the sentiments of the respondents regarding the organization's safety culture. The qualitative analysis utilized a phenomenological framework that allowed the respondents to share their lived experiences in the specified area of study. A significant theme identified from the responses focused on policy making in the organization, specifically related to a "no show" policy. These results supported previous research in the literature review and the SEM model that highlighted the role of policy-making in an organization having a significant impact on safety awareness and culture. Additionally, the theme of information sharing in improving safety culture supported the need for management to share data, trends, and policy changes with employees to improve trust and accountability. The results of the qualitative data were coherent with the SEM analysis and previous literature on the subject; however, it adds to the literature on incorporating a robust safety culture in a flight training environment through an increased focus on policy-making and better-informed communication from management.

Discussions and Conclusions

The overall purpose of this study was to investigate flight students' perceived safety culture at a Title 14 Code of Federal Regulations (CFR) Part 141 flight training school in the Southeast region of the United States. The results suggested a direct and strong predictive relationship between safety culture in collegiate flight training and the perceptions of respondents of the safety value and safety personnel multidimensional constructs of safety culture. Based on the operational definition of the constructs, Safety Personnel and Safety Values were directly related to the policy, objectives, and actions of the management of the Flight Department. An effective indicator of a strong safety culture is top-management overall safety vision, values, and commitment to safety (von Thaden & Gibbons, 2008). A Part 141 flight training organization's safety culture can be strengthened by making visible the commitment of senior leadership management and by actively involving personnel in the management of safety risks. "When management actively endorses safety as a priority, it is typically well-received by personnel and becomes part of normal operations" (ICAO, 2018, p. 1-2). According to Reason (1998), a safety report allows aviation professionals to let safety professionals investigate each single hazard, and it is considered a necessary step in the organization's accident prevention efforts. Most importantly, a reporting culture is an intrinsic element of a safety culture. While 81% (n=322) of students had never submitted a safety report, and only 3% (n=11) had submitted three or more safety reports, this could be attributed to the fact that 97% of flights are conducted with a flight instructor on board. Typically, the flight instructors will fill out the safety reports, the great majority of times, alongside their students. It is plausible to assume that most student-initiated safety reports are from their solo flight activities.

The textual data was used to analyze the impact of Safety Values and Safety Personnel on students' perceptions. Findings indicated that students have positive sentiments regarding the organizational safety values of the Flight Department. While the qualitative analysis highlighted some negative sentiments regarding specific policies, especially the No-Show policy, the overall safety culture and awareness for students are positively influenced by the safety values instilled by management and safety personnel. Respondents' feedback can be utilized to modify policies and to improve the safety culture and communication.

Researchers acknowledged that there are limitations to this study. For example, the narrow band of age and flight experience, as well as the sample size, will not make the results generic to other aviation professionals outside that domain. Psychosocial and other human factors such as stress, family issues, workload, and organizational pressures may have biased the opinions of respondents. Only 24% of the respondents were international students. Additionally, only 10% of them were CFIs. The research team attempted to collect data from collegiate aviation pilots with different flight experiences, enrollment levels, nationalities, and flight certificates in order to have a better picture of how these students perceived their organization's safety culture. As suggested by Adjekum et al. (2016), previous safety events experienced by participants and or their colleagues could have influenced their perceptions of the safety culture elements. In addition, students within the organization are being instilled with safety culture concepts during ground and flight training and education, as suggested by Ayres et al. (2009). Students are being mentored and influenced by the organizational safety culture, the safety values of the organization, and their instructors are being espoused on them through mentorship. Through the affective domain, this mentorship is molding their values and beliefs in safety. As a result, their perceptions of the organizational safety culture may be incomplete/premature as they are in the process of learning the culture through mentorship and immersion. The stated limitations could potentially bias some of the findings in this study and affect generalizability across the entire aviation workspace.

Recommendations

Recommendations for future research should focus on increasing the sample size of student participants taking the Safety Culture survey and revising factors and constructs based on continuous feedback and changes. Increasing the sample size would improve the validity of the model and help utilize textual data for correlational analysis utilizing principles of Natural Language Processing. Future research should also consider implementing a similar survey for other staff members of the Flight Department, such as the maintenance technicians and dispatch. Implementing the survey for different staff members will ensure a more comprehensive sampling strategy and assist in identifying significant factors and constructs for Safety Culture and Awareness. Identifying significant factors will assist in designing Safety Management System (SMS) training for staff and students. Gathering quantitative and qualitative inputs from students on perceived risks and factors would allow for the continuous review of model factors and qualitatively validate findings. Finally, future research should utilize existing safety data infrastructure to identify factors and trends to improve model development and factor analysis for further studies. More importantly, our findings could provide the scientific foundation for academic policies, flight training, and educational safety efforts to strengthen the safety culture of pilots in a Part 141 collegiate aviation environment. After all, "safety culture does not just happen by chance. It is the product of deliberate efforts by senior management without which any good safety record will be transient" (ICAO, 2002, p. 3-8).

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Appendix A

Safety Values

Safety Values refer to the "attitudes and values expressed in words and actions by leadership regarding safety" (Von Thaden & Gibbons, 2008. p.11). In other words, it refers to the values the Flight Department's leadership places on safety. Leadership refers to the Flight Department Chair, Chief Flight Instructor, Assistant Chief Pilot Instructors, and the Training Managers. Safety performance should be consistently monitored and evaluated with the same attention to exceeding goals or finances. To capture this, the following questions were used:

SV1. The leadership in my Flight Department considers safety as a core value
SV2. The leadership in my Flight Department is more concerned about being safe than making money
SV3. The leadership in my Flight Department shows concern for safety before an accident or incident happens
SV4. The leadership in my Flight Department does not cut corners when safety is concerned
SV5. The leadership in my Flight Department does not expect pilots to complete flight training activities if it means compromising safety

Promotion of Safety

Promotion of safety refers to "compliance with regulated aspects of safety such as training requirements, manuals and procedures, equipment maintenance, and the coordination of activity within and between teams/units" (Von Thaden & Gibbons, 2008, p. 11). At this level, the Flight Department should encourage safe business practices and provide a solid framework for the organization, managers, and flight instructors to meet predetermined safety requirements. Therefore, the following questions were used:
PS1. My Flight Department's checklists and procedures are easy to understand
PS2. My Flight Department is willing to invest resources to improve safety
PS3. My Flight Department is committed to equipping aircraft with up-to-date technology
PS4. My Flight Department ensures that maintenance on aircraft is adequately performed
PS5. My Flight Department ensures that aircraft are safe to operate

Safety Commitment

Within the original SCISMS framework, Safety Commitment was formerly labeled as Going Beyond Compliance. This factor was renamed to Safety Commitment to more accurately capture flight students' perceptions of their flight instructor's commitment to safety. Safety Commitment refers to the "priority given to safety in the allocation of company resources (e.g., equipment, personnel time) even though they are not required by regulations" (Von Thaden & Gibbons, 2008, p. 11). This may be reflected in rostering, scheduling shiftwork and rest time, fatigue management programs, and risk management programs. The following questions were used:

SC1. The leadership in my Flight Department views violations (e.g., airspace violations, flight operations manual non-compliance) very seriously, even when they do not result in any serious damage or injury
SC2. The leadership in my Flight Department seeks more than regulatory minimums when it comes to issues of flight safety
SC3. The leadership in my Flight Department ensures that my Flight Instructors are not fatigued during activities
SC4. The leadership in my Flight Department does not try to get around safety requirements

Reporting System

In addition to a safety-related event data collection system, CFR Part 141 flight departments must have a non-punitive reporting system to encourage safety reporting. To assess the utility of the Aviation Safety Reporting System within the Flight Department, the following questions focused on capturing perceptions surrounding accessibility, familiarity, and actual use of the organization's safety reporting system.

RS1. The safety reporting system is convenient
RS2. I can report safety discrepancies without fear of negative repercussions
RS3. I am willing to report information regarding the unsafe actions of other pilots
RS4. I am willing to file reports about unsafe situations, even if the situation was caused by my own actions

Effective Communication and Effective Feedback

The original SCISMS framework labels this factor as Response and Feedback, referring to the "timeliness and appropriateness of management responses to reported safety information and dissemination of safety information to workers" (Von Thaden & Gibbons, 2008, p. 13). However, the current study broke this down even further into Effective Communication and Effective Feedback. According to Reason (1998), the effective communications of an organization's safety values and beliefs are critical, and a strong safety culture is present when each individual is clear on what behavior the organization considers acceptable or unacceptable. The questions for effective communication were adapted from a survey by Grabowski et al. (2009).

EC1. Safety issues raised by pilots are communicated regularly to all other pilots
EC2. There is good communication in the Flight Department about safety issues
EC3. The Flight Department is very effective in communicating safety information
EC4. I am kept informed about the Flight Department's safety information
EF1. When a pilot reports a safety problem, it is corrected in a timely manner
EF2. The Flight Department keeps the feedback regarding safety concerns confidential
EF3. I am satisfied with the way the Flight Department deals with the safety reports
EF4. I am given feedback on accidents, incidents, near misses, or injuries that occur in the Flight Department

Safety Personnel

Safety personnel refers to the "perceived effectiveness of and respect for people in formal safety roles" (Von Thaden & Gibbons, 2008, p. 13). Within a CFR Part 141, the safety personnel within the Flight Department refers to the Director of Aviation Safety and the Aviation Safety Program Manager. To capture the perceived commitment of formal safety personnel, the following questions were used:
SP1. Personnel responsible for safety hold high status in the university
SP2. Personnel responsible for safety have the power to make changes
SP3. Personnel responsible for safety have a clear understanding of the risks involved in flight
SP4. Safety personnel demonstrate a consistent commitment to safety

Safety Training

Safety Training is the "extent to which those who provide safety training are in touch with the actual risks and issues associated with performing a particular activity and the extent to which training is offered and is deemed effective" (Von Thaden & Gibbons, 2008, p. 12). These questions were chosen to provide insight into how effectively safety training is integrated throughout the Flight Department.

ST1. The flight instructors prepare me for various safety situations, even uncommon or unlikely ones
ST2. The flight instructors do not teach ways to get around safety requirements
ST3. The flight instructors consistently emphasize safety during training
ST4. The flight instructors have a clear understanding of the risks associated with flight operations

Multicultural Operations

With a large number of international students and flight instructors, it is important to consider how multicultural operations impact safety culture and communication. Wang (2008) and Byrnes (2015) suggested that multicultural operations could be an essential factor influencing safety performance, especially in regard to multi-cultural backgrounds and language barriers. Therefore, 'Multicultural operations' was also added to the framework and the following questions were used:

MO1. Language differences in multi-cultural flight instructors are not a threat to safety
MO2. I enjoy working with multicultural flight instructors
MO3. There are no differences in the performance of flight instructors from different cultures

Informal Safety Indicators

Informal safety indicators included three factors - accountability, employee authority, and professionalism; however, informal safety indicators were deleted from the modified framework as they reflect employees' perception of safety culture rather than those of the students.

Operations Interactions

Operations interactions refers to “the degree to which those directly involved in supporting work or the supervision of [students] are actually committed to safety and reinforce the safety values espoused by upper management when these values are positive” (Von Thaden & Gibbons, 2008, p. 12). Operations interactions are reflected in relationships with supervisors, flight instructors, and other operations personnel with consideration for safety. To glean insight into the safety climate of those working directly with flight students, questions were asked to assess the extent to which flight instructors promote safe operations, as well as weigh the influence Multicultural Operations may have on students’ perceptions of safe operations.

Safety Behavior/Outcomes

Safety behavior or safety outcomes are reflected in the outcome variable, perceived organizational risk. The questions selected provide meaningful insight into students’ perceptions regarding the likelihood of a negative safety event occurring. The safety culture of a flight school is expected to predict safety behaviors based on students’ perceptions of risk (Cooper & Phillips, 2004). Thus, gleaning insight into the level of trust and confidence students have in their organization’s safety culture could potentially aid in early risk mitigation strategies.

Perceived Organizational Risk

Serving as an outcome variable, the Perceived Organizational Risk scale addresses a student’s beliefs about the likelihood of negative safety occurrences at the Flight Department. This constitutes a global evaluation of the students’ assessments of the Flight Department’s overall safety level. This measure also provides insight into what students perceive as being out of their control and the responsibility of the flight department itself.

SR1. Someone in the Flight Department is likely to be involved in an accident over the next twelve months
SR2. Someone in the Flight Department is likely to be involved in an incident over the next twelve months
SR3. Someone in the Flight Department is likely to be cited by the FAA for a major safety violation over the next twelve months

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

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

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

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

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

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

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

Literature Review

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

Cultural and Demographic Factors

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

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

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

Cross-cultural Differences in Consumer Attitudes Towards New Aircraft

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

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

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

Demographic Factors and Passenger Acceptance

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

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

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

Economic Factors Affecting Consumer Willingness to Fly

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

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

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

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

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

Psychological and Emotional Factors Influencing Passenger Acceptance

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

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

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

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

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

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

Other Factors and Theories Related to Willingness to Fly

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

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

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

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

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

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

Method

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

Participants

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

Materials and Procedure

WTF Scale Development

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

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

Adaptation of the WTF Scale

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

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

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

Design and Purpose

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

Results

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

Familiarity with AAM and eVTOLs

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

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

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

Willingness to Fly: Flight Scenarios

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

Table 2
Mean WTF Scores for Each Scenario

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

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

Table 3
Differences in Scores among Scenarios

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

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

Willingness to Fly on Specific Aircraft Models

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

Table 4
Cross-comparison of WTF among eVTOL models

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

Note. NS = not significant

Figure 1
eVTOL Model 1

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

Figure 2
eVTOL Model 2

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

Figure 3
eVTOL Model 3

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

Figure 4
eVTOL Model 4

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

Figure 5
eVTOL Model 5

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

Concerns that may influence WTF eVTOLs

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

Demographic Analysis

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

Table 5
Percentages of Concern Type Selected by Respondents

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

General Demographic Attributes

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

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

WTF versus respondent attributes

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

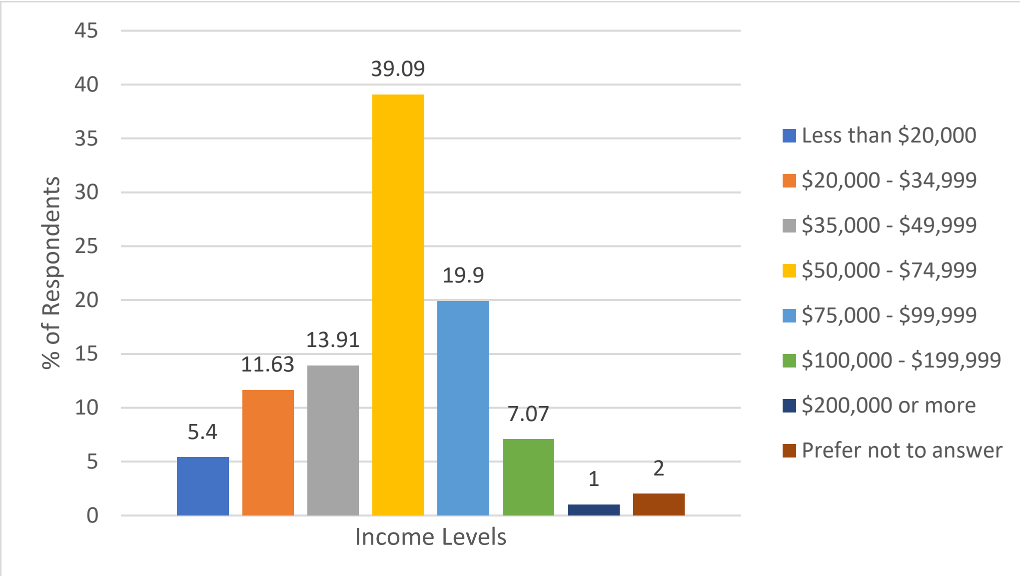
WTF values were next compared across genders. A Mann-Whitney *U* test was conducted, which indicated significant differences between genders, with males having a higher average WTF score ($U = 94245.5$, $p < 0.001$, $d_{Cohen} = 0.28$). A Spearman correlation was utilized to determine if there was a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

Table 6
Ethnicities of Respondents

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

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

Figure 6
Distribution of Income for Respondents



WTF versus Respondent Attributes

A more in-depth examination of the data compared the average WTF scores with various respondent attributes. The WTF was highest among those most familiar with AAM and eVTOLs. Also, the WTF was highest among those excited or very excited about flying on eVTOLs. The top WTF scores occurred among those reporting that they would be among the first to fly on an eVTOL, followed by those planning to fly on one a few months after introduction. The lowest WTF scores were among those wanting to wait the longest to fly an eVTOL or planned to never fly on one. See Figures 7 through 10 for visualizations of these findings (note: these figures display data in percent of responses within the specific category, e.g., familiar, not familiar).

WTF values were next compared across genders. A Mann-Whitney U test was conducted, which indicated significant differences between genders, with males having a higher average WTF score ($U = 94245.5$, $p < 0.0001$, $d_{Cohen} = 0.28$). A Spearman correlation was utilized to determine if there was a relationship between WTF and age. Data indicated that there was a weak, negative correlation between WTF and age ($r_s[398] = -0.198$, $p < 0.0001$).

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

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

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

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

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

Note. NS = not significant

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

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

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

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

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

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

Table 8

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

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

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

Discussion

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

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

Figure 7
Correlations between Income Ranges and WTF Scores

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

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

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

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

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

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

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

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

Limitations

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

Delimitations

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

Conclusion

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

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

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

Recommendations

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

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

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Understanding Collegiate Flight Students' Perceptions and Realities of Depression and Anxiety

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As a result of recent incidents and other circumstances, shared questions and potential problems related to mental health and aviation have surfaced within collegiate aviation programs. The purpose of this study is to provide a better understanding of collegiate aviators' attitudes toward mental health in aviation, how they manage their mental health, how these practices may transition into their flying careers, and whether the current FAA aeromedical standards are professionally written to protect these and other aviators. The researchers conducted a mixed methods study to identify a common knowledge base of collegiate flight students' perceptions and realities related to depression and anxiety. Study participants were bachelor's degree seeking flight students from University Aviation Association (UAA) member collegiate flight programs. The received responses were analysed through the perspective of four research questions. In summary, gathered responses indicated that students believe there is a perceived benefit to not disclosing or ignoring mental health and fitness issues, safeguarding their own mental health is one of their primary concerns, and there is a considerable number who would leave the aviation industry if they could no longer fly. Additionally, most students agree that change would be beneficial as it relates to the current FAA medical certification process.

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Introduction

The Federal Aviation Association (FAA) has formally enumerated a particular methodology for examining and diagnosing mental health conditions within the required medical exam process. The Administration's structured guide must be followed by trained and approved Aviation Medical Examiners (AMEs) who review both new and existing pilot medical certification applications (Federal Aviation Administration, 2022). Varying levels of medical certification allow these personnel to act in the capacity identified by their FAA issued airmen privileges (Code of Federal Regulations, 2023).

Considering its importance to overall well-being and performance, mental health is a crucial aspect that is focused on during the FAA aeromedical application process. In terms of the number of covered items and descriptions thereof, the mental health portion of the exam is comprehensive and focuses on several criteria. For an applicant's successful passing of this section, they must not have been diagnosed or have an established history of four identified disqualifying diagnoses. These diagnoses are (1) a personality disorder, (2) a psychosis, (3) a bipolar disorder, and (4) substance dependence (Code of Federal Regulations, 2023). In addition to the noted, symptoms of anxiety and depression, as well as formal diagnoses, are also grounds for aeromedical application denial (Federal Aviation Administration, 2022).

The occurrence rate of depression and anxiety in the aviation community is like that of the public, approximately 6% of the population (Transport Canada, 2019). Additionally, the level of reported mental illness in the 18- to 25-year-old age range (i.e., the age typically associated with college students) was the highest of any population group, at 30.6% in 2020 (Substance Abuse and Mental Health Services Administration, 2021).

The repercussions of medical certification denial can be both career and life defining (Blue, 2016). As a result, many aviators are careful to balance their personal well-being with careful consideration of their futures (Blue, 2021). Arguably, there is not a more professionally defining time in one's life than college. For students enrolled in a collegiate flight program, the pursuit of flight ratings, and ultimately a flying job post-graduation, is inexplicably tied to their ability to be granted and continually hold an FAA first-class medical certificate. In some cases, but less frequently, a second-class medical certificate is the highest level of FAA-issued medical certificate that a pilot carrying passengers for hire is required to hold (Federal Aviation Administration, 2016).

Statement of the Problem

The FAA's aeromedical examination process criteria related to mental health, identified in 14 CFR Part 67-Medical Standards and Certification, has not been amended since 1996 (GovInfo, 1996). Regulations related to the use of selective serotonin reuptake inhibitors (SSRIs) for anxiety and depression were last revised in 2010 (U.S. Department of Transportation, 2010). Most recently, in 2016, third-class medical restrictions were relaxed for pilots requesting initial and subsequent certificate issuances with the introduction of BasicMed (Federal Aviation Administration, 2017). Additionally, there are pathways that exist that applicants can follow to be further considered by the FAA for medication certification if they have certain disqualifying or other conditions. These pathways exist for those with certain mental health disorders, such as anxiety and depression (Aircraft Owners and Pilots Association, n.d.).

Irrespective of the latest revisions to the aeromedical process or additions of new certification pathways, there has been increased attention on mental health in the flying population throughout recent years. Callouts prompting additional industry focus on mental health have originated in well-respected industry publications, online forums, aviation non-profit advocacy foundations, and other sources. Many of these voices collectively advocate for Aeromedical Reform, the dynamic concept of aeromedical standards' revision in the United States (Laczko, 2023). These requests center around policy change of varying forms, but almost all of which request an in-depth review of the current aeromedical certification process and identification of aspects that could be improved (Goyer, 2021).

Some of the increased industry attention has been brought forth by concerned parties who have explained their own or others' struggles with mental health and flying. These personal stories contribute to the narrative surrounding the increased interest in this topic. One of the most compelling viewpoints about mental health and flying was posthumously offered. Since October of 2021, some of the expanded attention towards pilots' mental health has been the result of a high-profile incident involving a freshman collegiate flight student, John Hauser. The nineteen-year-old University of North Dakota private pilot's intentional airplane crash has since highlighted the juxtaposition of mental health within collegiate flight programs across the country (Wildes, 2022). While the hopeful airline pilot could not overcome his struggles with mental health and the perceived repercussions of seeking help, he left his loved ones with one request. Hauser wrote in a letter to his parents "If you can do anything for me, try to change the FAA rules so that other young pilots don't have to go through what I went through" (ABC 7 Chicago, 2022).

As a result of this incident and other circumstances, some common questions and potential problems related to mental health and aviation have surfaced within collegiate aviation programs. A sampling of the potential issues and related questions that affect flight students in these programs include (1) whether flight students forgo professional help for their mental health concerns, (2) how flight students manage mental health concerns, (3) flight students' perceptions about the FAA's stance on mental health disorders, (4) flight students prioritizing their careers over their mental health, and (5) flight students developing an unhealthy reliance upon flying as their sole identity. These statements will help to guide the research in better understanding students' attitudes towards mental health.

For many of these students, the transitional aspect of college is one of the most defining periods of their lives. During their undergraduate tenure, students work to better themselves academically while preparing for life post-graduation (Montgomery & Cote, 2008).

Purpose of the Study

The purpose of this study was to document United States collegiate flight program students' sentiments towards mental health and its impact on required flight training undertaken during their undergraduate tenure, as well as their flying careers thereafter. This in-depth examination provided a better understanding of these aviators' attitudes towards mental health in aviation, how they manage their mental health, how these practices may transition into their flying careers, and whether the current FAA aeromedical standards are properly written to protect these and other aviators, as well as the public. The study's purpose was also to guide recommendations related to potential future improvements to the aeromedical examination and certification process' mental health criteria and educate collegiate flight programs about this omnipresent topic.

Significance of the Study

The significance of the study was related to the impact of potential mental health issues among pilots within the respondent population of collegiate flight programs. Because this topic has not been thoroughly researched, specifically regarding collegiate flight students' perceptions and realities surrounding mental health, more clarity was needed on the subject. A focused examination of the subject helped to reveal opportunities for the FAA to better support pilots in training through flexible mental health reform that is aligned with present-day mental health standards. As a result of this research, collegiate flight programs will be able to better support their students, including those who may suffer from mental health disorders and those going through challenging periods during their collegiate tenure.

Research Questions

The following four questions were written with the purpose of helping to create a better understanding of collegiate flight students' perceptions regarding mental health:

RQ1: What are collegiate flight students' perceptions regarding mental health disclosure based on the current aeromedical process?
RQ2: Do collegiate flight students view disclosing mental health struggles as having a negative impact upon their careers?
RQ3: What strategies do collegiate flight students use to manage their mental health and what are these strategies' effectiveness?
RQ4: Do collegiate flight students feel there is a tangible benefit to pilots and the public if the current first-class medical certification standards related to mental health aspects are revised?

Research Methodology

This study employed a mixed-methods approach to gather both qualitative and quantitative data through an online-administered survey. The survey was created by the researchers and consisted of three sections. Each question within the survey was specifically coded, requiring the participant to provide a response so that no partial surveys were submitted to the researchers. This helped to ensure that a more complete understanding of each participants' concerns surrounding mental health issues (particularly anxiety and depression) was gathered. As a result, a more representative data set existed, allowing the researchers to draw appropriately guided conclusions and recommendations.

The first section of the survey focused on the personal information of each participant, with the goal of extracting suitable information to build a demographic profile of the survey's respondents. This personal information was relevant to the research topic, as it helped to assign a collective identity to the survey's participants. With an appropriate number and types of participants, the sample would be representative of the studied population (Sheppard, 2019, p. 111). The second section prompted participating flight students to provide their own written responses to open-ended questions. These questions helped to bring individual voice to the group of participants and their concerns surrounding mental health. Additionally, the comments provided by the participants helped to identify context and themes, potentially highlighting elements or concepts not specifically asked for by the researchers. The final section of the survey consisted of Likert Scale statements, which solicit participants' thoughts and perceptions on a variety of topics related to mental health and flight training. The students' responses to these statements provided clarity to their open-ended answers.

Study Participants

Participants for this study were those who responded to the researcher's request for participation. The survey, as well as the accompanying background information and voluntary consent statement, was sent to the University Aviation Association (UAA)-member collegiate flight programs that offer four-year Professional Pilot, Commercial Aviation, and similar degree options. Program directors from 66 programs were identified and contacted to disseminate the anonymous survey link to their institution's flight students at their discretion. All participating students provided their voluntary consent to be a part of the research study.

The researcher targeted 100 completed surveys. This was determined as an appropriate sample size that accurately reflected the collegiate flight student population and minimized sampling error (Sheppard, 2019, p. 111-112). Two weeks after the researcher's initial email, a follow-up message was sent. The survey was closed for response at the conclusion of 45 days. In total, 95 complete survey responses were collected during the spring 2023 academic semester. Due to the anonymity of the survey collection process, the geographic dispersion and other potentially identifying information of completed surveys is unknown. The only known demographic data were those asked in the survey, which were gender, academic classification by credit hour, level of held FAA medical certificate, held FAA pilot certificates/ratings, number of logged flight hours, and career aspirations.

Validation Process

The reliability of the 24-question survey was ensured through the incorporation of several measures. The administered questionnaire's elements were carefully considered, so that the survey's length was appropriate and provided clarity towards the ideated research questions. Each of the survey's 24 questions was written in such a way as to minimize the potential for misunderstandings within the responding participant population.

The validity of the survey questions was established by forwarding the questions to industry professionals known to the researchers. These individuals were asked to examine the set of survey questions and confirm its focus on the related research topic and verify its clarity in wording and instruction. Their comments and suggestions were then used to further edit and improve the survey questions.

Statistical Analysis of the Data

The collected data was analyzed using a variety of common statistical methods to identify trends and other pertinent factors. Identification of these details allowed the researchers to provide a detailed findings section, as well as evidence to support logical conclusions.

The six multiple choice questions, focusing on demographic related information, were examined using descriptive statistics. According to Dunn and Clark, “With descriptive statistics, we summarize data, making calculations, tables, or graphs that can be comprehended easily” (Dunn & Clark, 2002, p. 1). The thirteen Likert scale questions, as well as the five short-answer questions, were also analyzed using descriptive statistics, in addition to statistical inference. There are several categories of measurement classified as descriptive statistics, including measures of variability (or spread), frequency distribution, and measures of central tendency (Hayes, 2022). Frequency distribution was the best method for review of the collected data, as it focuses on expressing the number of times a data point was chosen. As a result, “a frequency distribution allows one to easily see the most popular answers for all types of questions within the survey, through the use of percentages and other figures” (Dunn & Clark, 2002, p. 4). These distributions were useful in guiding the researchers’ determination of conclusions from the research questionnaire, as well as recommendations.

Measuring of central tendency is another descriptive statistics technique used to analyze the collected data. Measures of central tendency focus on the average or middle values of data sets and include the mean, median, and mode (Hayes, 2022). Statistical inference, also referred to as inferential statistics, is also relevant when creating conclusions that are supported by fact. Statistical inference is based on the mathematical theory of probability and involves drawing conclusions from the data (Dunn & Clark, 2002, p. 1).

All of the participants’ survey data were analyzed by the researchers using data analysis completed within the Qualtrics XM software, ensuring the strongest integrity in data translation and application to support the study’s four research questions. The Qualtrics XM software provided outputs to several statistical tests that are commonly used descriptive statistics measures. Results and interpretations from the statistical analysis of the collected data are provided in the findings.

Last, another data summarization method was the categorization of participant responses to the open-response questions. Following the review of the responses to each of the five questions, answers were manually coded with a number that corresponded to a commonly expressed thought. The coded responses were subsequently grouped, then the groupings of data were shown through a frequency distribution.

Findings

Collegiate Flight Students’ Demographics

Question 1 of the research survey asked each participant to indicate their gender. Table 1 shows that 71 (75%) of the respondents indicated they were males, and the remaining 24 (25%) students indicated they were female.

Table 1
Collegiate Flight Students' Gender

Gender	Responses	Percentage of Responses
Male	71	75%
Female	24	25%
Prefer Not to Answer	0	0%
Gender Not Listed	0	0%

Question 2 of the research survey asked each flight student to indicate their current academic classification with respect to the number of completed student credit hours (Table 2). Of the 95 total responses, 36% of the participants stated they were freshmen and sophomores, and the remaining 64% of participants were juniors and seniors.

Table 2
Collegiate Flight Students' Completed Credit Hours

Academic Classification	Responses	Percentage of Responses
Freshman	16	17%
Sophomore	18	19%
Junior	27	28%
Senior	34	36%

The third question asked participants to indicate which class of FAA-issued medical certificate they held at the time of completing the survey. As Table 3 shows, all the participants had a medical certificate. The responses showed that 83% of the students held a first-class medical and 17% of students held a second-class or third-class medical.

Table 3
Collegiate Flight Students' Medical Certificate Class

Medical Certificate Class	Responses	Percentage of Responses
First	79	83%
Second	5	5%
Third	11	12%
None	0	0%

Question 4 requested flight students state which FAA pilot ratings and certificates they held at the time of the survey (Table 4). Most of the participating students (67%) indicated they were private pilots, 33% of the flight students were student pilots, and 17% were commercial pilots. In addition, 36% of the students had earned an instrument rating and 12% had earned a multi-engine rating. Lastly, 7% of the participating students were certified flight instructors.

Table 4
Collegiate Flight Students' Pilot Ratings and Certificates

Certificates/Ratings	Responses	Percentage of Responses
Student Pilot	32	33%
Private Pilot	64	67%
Commercial Pilot	16	17%
Airline Transport Pilot	2	2%
Instrument Rating	34	36%
Multi-Engine Rating	11	12%
Certified Flight Instructor	7	7%
Certified Flight Instructor-Instrument	1	1%
Other	1	1%

Note. The total percentage of responses is greater than 100% because this question allowed participants to select more than one answer.

Question 5 asked flight students to indicate how many flight hours they have logged in total. Table 5 shows that most students (70%) had less than 200 hours of flight time in the cockpit. And only 11% of students had logged 300 or more flight hours.

Table 5
Collegiate Flight Students' Total Number of Flight Hours

Number of Hours	Responses	Percentage of Responses
0-99	34	36%
100-199	32	34%
200-299	18	19%
300-399	7	7%
400+	4	4%

Collegiate Flight Students' Open-ended Responses

The second section of the research survey requested the participating students to provide personal responses to the five open-ended questions. The first question asked participants to indicate how they manage stress and anxiety. Each of the 95 participants identified various techniques for how they handle stress and anxiety in their daily lives. After coding the survey data, Table 6 lists the common themes identified by the researchers. Approximately one-third of the students (34%) indicated they manage stress and anxiety by pursuing various other hobbies, including reading, writing, spiritually focused efforts, listening to music, watching television, and playing video games. Thirty-one percent of students mentioned spending quality time alone and relaxing, and 26% of students managed anxiety and stress by exercising.

Table 6
Collegiate Flight Students' Mental Health Management Techniques

Stress and Anxiety Management Techniques	Responses	Percentage of Responses
Planning/Time Management	21	22%
Exercise	25	26%
Time With Family/Friends	19	20%
Various Hobbies	32	34%
Alone Time/Relaxation	29	31%
Ignoring The Issue(s)	3	3%
Flying	4	4%
Other	15	16%

Note. The total percentage of responses is greater than 100% because this question allowed participants to provide multiple responses.

The second open-ended question asked the students if they had a backup career goal in the event of an aeromedical certificate issue. Approximately one-half of flight students (52%) indicated they would continue to work in the aviation industry even if they could no longer fly (Table 7). And 35% of students explicitly stated they would pursue a career in a non-aviation industry if they could no longer be a pilot.

Table 7
Collegiate Flight Students' Backup Career Goals

Backup Career Plan	Responses	Percentage of Responses
Aviation Industry	49	52%
Other Industry	33	34%
No Plans or Alternate Ideas	13	14%

The third open-ended question asked students if their application for an FAA medical (of any class) has ever been denied for any reason. As shown in Table 8, only 4% of collegiate flight students had an issue obtaining their medical certificate. These students indicated the additional concerns, given their individual cases, were due to (1) a visual color deficiency, (2) childhood ADHD, (3) hypothyroidism, and (4) habitual headaches. However, none of the students indicated a mental health condition as the cause for a medical certificate denial.

Table 8
Collegiate Flight Students' Medical Certificate Denial Experiences

Medical Denial	Responses	Percentage of Responses
Yes	4	4%
No	91	96%

The next open-ended question asked students if they currently held a Special Issuance medical. Like the previous question, 4% of flight students currently hold a Special Issuance medical certificate (Table 9). The students identified hypothyroidism, pre-menstrual pain and anxiety, childhood anxiety and depression, and a bleeding disorder as the reason they had the special medical. One additional student commented that they did not currently have a Special Issuance medical but stated they expected to have one soon due to depression.

Table 9

Collegiate Flight Students' Special Issuance Medical History

"Special Issuance" Medical	Responses	Percentage of Responses
Yes	4	4%
No	91	96%

The last open-ended question asked students if they had any suggestions for how to improve the current FAA aeromedical certification process (including aspects related to mental health). As shown in Table 10, the comments provided by the participating students focused on a wide array of aspects within the aeromedical certification process, including mental health. Of the five open-ended questions, the collegiate flight students were collectively the most descriptive when answering this question. Several novel and repeated opinions were expressed with 39% of students specifically mentioning mental health. One student stated, "As students, we would be willing to talk about our depression and anxiety concerns, but out of fear of how the FAA will react, we do not seek help. So, we just deal with it and press on, causing untold levels of mental fatigue. All this fatigue leads to a fragile mental state." A second student added, "I feel that mental health in aviation is not addressed enough, especially for female flight students. As a female, there are fewer female peers to connect with and talk to, while there is an increased amount of pressure to perform well in the cockpit since you are constantly being compared to males."

Additionally, 24% of students commented that they hoped any future revision in the certification process would be less punitive to pilots. Lastly, 44% of flight students indicated they had no suggestions for a potential process revision.

Table 10

Collegiate Flight Students' Aeromedical Certification Process Improvement Suggestions

Process Improvement Suggestions	Responses	Percentage of Responses
Mental Health Related	37	39%
Other Conditions	5	5%
Being Less Punitive to Pilots	23	24%
Other Aspects	12	13%
Not Sure/No Suggestions	42	44%

Note. The total percentage of responses is greater than 100% because this question allowed participants to provide multiple responses.

Collegiate Flight Students' Perceptions Regarding Mental Health

The last section of the survey consisted of thirteen Likert scale statements. Each question had five options for participants to rank their feelings, including Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D), or Strongly Disagree (SD). Table 11 provides a summary of data from the first four Likert statements regarding mental health disclosure. Almost one-half of flight students (46%) disagreed with the statement, "The FAA has my best interests in mind, in terms of mental health disorder diagnosis, disclosure, and treatment." One of these students responded, "The fear of never flying again is why no one gets help for mental health issues." Another student added, "The FAA needs to understand that pilots are human and have human emotions and thus need to provide resources that will not penalize a pilot for feeling sad or anxious." Only 27% of students agreed with the statement. Conversely, almost all students (91%) agreed with the statement, "It is dangerous for pilots to hide their mental health disorders." Two-thirds of students (68%) agreed with the statement, "The current FAA medical certification process encourages dishonesty in relation to mental health disorders." And only 9% of participating students disagreed with the statement. Regarding the statement, "I am aware of pilot(s) who have been dishonest during the FAA medical certification process in relation to mental health disorders," 38% of students agreed with the statement, and 35% of students disagreed.

Table 11
Collegiate Flight Students' Perceptions Regarding Mental Health Disclosure

Likert Scale Statement	SA	A	N	D	SD
The FAA has my best interests in mind, in terms of mental health disorder diagnosis, disclosure, and treatment.	6 (6%)	18 (19%)	27 (28%)	26 (28%)	18 (19%)
It is dangerous for pilots to hide their mental health disorders.	53 (56%)	33 (35%)	8 (8%)	1 (1%)	0 (0%)
The current FAA medical certification process encourages dishonesty in relation to mental health disorders.	26 (28%)	39 (41%)	21 (22%)	6 (6%)	3 (3%)
I am aware of pilot(s) who have been dishonest during the FAA medical certification process in relation to mental health disorders.	12 (12%)	24 (25%)	26 (28%)	23 (24%)	10 (11%)

Table 12 summarizes data from the three Likert statements regarding mental health and career impacts. Most collegiate flight students agreed their flying careers were contingent on their ability to successfully complete an FAA medical examination and receive a medical certificate. Regarding the Likert statement, "If I failed to receive an FAA medical at the time of my physical examination, then my flying career would be in jeopardy," 85% of students agreed, and only 4% disagreed with the statement. Similarly, 71% of students agreed with the statement, "If I told an Aviation Medical Examiner (AME) that I was depressed or anxious, then I would no longer be able to fly." Regarding this statement, a student commented, "There is an incredible stigma in having any mental health struggle because if we report it on the medical, the chances of getting deferred by the AME and being grounded while the FAA slowly asks a lot of questions and orders a bunch of expensive tests is high." Only 9% of students disagreed with the statement. In relation to the second open-ended question, collegiate flight students were asked to indicate their perceptions regarding a backup career plan if they were denied a medical certificate. More than half of the students (61%) agreed with the statement, "I have thought about what career I would pursue if I was denied an FAA medical certificate." Approximately one-fourth of students (27%) have not thought about a backup career plan.

Table 12
Collegiate Flight Students' Perceptions Regarding Mental Health and Career Impacts

Likert Scale Statement	SA	A	N	D	SD
If I failed to receive an FAA medical at the time of my physical examination, then my flying career would be in jeopardy.	39 (41%)	42 (44%)	10 (11%)	3 (3%)	1 (1%)
If I told an Aviation Medical Examiner (AME) that I was depressed or anxious, then I would no longer be able to fly.	30 (32%)	37 (39%)	19 (20%)	9 (9%)	0 (0%)
I have thought about what career I would pursue if I was denied an FAA medical certificate.	23 (24%)	35 (37%)	11 (12%)	19 (20%)	7 (7%)

Regarding collegiate flight students' perceptions related to mental health strategies, 81% of students agreed with the statement, "I adequately manage my stress and any mental health challenges that I face." Only 4% of students disagreed with the statement (Table 13). One of the students who disagreed with the statement commented, "Due to my mental decline, my passion for aviation has been almost completely drained to the point that it is hard to see a future for myself in the industry." Only 41% of flight students agreed with the statement, "My collegiate flight program has adequate mental health related resources." One of the students who disagreed with this statement stated, "Collegiate flight schools can make the experience easier on students but choose not to." Moreover, 65% of students agreed with the statement, "My professors, flight instructors, and others within my collegiate flight program care about my mental health." Furthermore, 17% of students disagreed with the statement. One of these students, disagreeing with the statement, commented, "Having so many bad experiences with flight instructors has had a strong negative impact on my flight training and my mental health. I have thought about leaving Part 141 flying because I am sick of being treated poorly while I'm trying to learn. My university does not seem to do a thorough job screening their flight instructors before hiring them. Most instructors make very little effort to teach because they are only in it for the hours to get to the airlines." And another student added, "At my university, I have had several flight instructors who raised their voice with me in the cockpit regarding simple mistakes, which makes it more difficult for me mentally. These instructor outbursts leave me on edge and anxious throughout the training flight."

Table 13
Collegiate Flight Students' Perceptions Regarding Mental Health Management Strategies

Likert Scale Statement	SA	A	N	D	SD
I adequately manage my stress and any mental health challenges that I face.	28 (29%)	49 (52%)	14 (15%)	2 (2%)	2 (2%)
My collegiate flight program has adequate mental health related resources.	5 (5%)	34 (36%)	30 (32%)	18 (19%)	8 (8%)
My professors, flight instructors, and others within my collegiate flight program care about my mental health.	22 (23%)	40 (42%)	17 (18%)	10 (11%)	6 (6%)

Table 14 shows a summary of data from the three Likert statements regarding collegiate flight students' perceptions related to revising the aeromedical certification process. One-half of participating students (52%) agreed with the statement, "I have a good understanding of the FAA medical certification process," whereas 16% of students disagreed with the statement. Approximately two-thirds of flight students (69%) agreed with the statement, "The current FAA medical certification standards are uncertain and subjective in relation to mental health disorders." On the contrary, only 7% of students believed these standards were clear and not subject to interpretation. Lastly, most students (84%) agreed the FAA mental health certification standards should be reviewed and potentially revised. One of the flight students remarked, "These FAA standards have always affected me in an extremely negative way in my life all because of the trouble it takes to be on medication that has helped me a lot. I hope things change because I want to fly, but the FAA is destroying the Gen Z pilot opportunities." And another student stated, "The FAA has a long way to go in addressing mental health needs. It cannot be ignored, and I find their policies about mental health to be absolutely barbaric. There needs to be a systematic change from within before it can be accepted instead of being stigmatized. Another suicide is waiting to happen if the FAA does not move." Last, another student added, "The FAA has an archaic viewpoint on mental health issues that alienates current and potential pilots. Their refusal to update medical policies and listen to science and medical professionals will continue to create serious safety issues as pilots attempt to secretly manage serious mental health issues without the support of a trained professional."

Table 14
Collegiate Flight Students' Perceptions Regarding Aeromedical Certification Process Revision

Likert Scale Statement	SA	A	N	D	SD
I have a good understanding of the FAA medical certification process.	11 (11%)	39 (41%)	30 (32%)	14 (15%)	1 (1%)
The current FAA medical certification standards are uncertain and subjective in relation to mental health disorders.	22 (23%)	44 (47%)	22 (23%)	7 (7%)	0 (0%)
The FAA mental health certification standards should be reviewed and potentially revised.	41 (43%)	39 (41%)	13 (14%)	1 (1%)	1 (1%)

Conclusions

This research effort highlighted the connection between mental health and collegiate flight students. Ninety-five collegiate flight students completed surveys, with most students having the following characteristics, male, senior classification (by student credit hour), a first-class medical, private pilot certificate, and have less than 200 hours of logged flight time. These students' responses were clear regarding their perceptions and realities related to mental health, and there was sufficient data collected to draw conclusions, as well as recommendations related to the topic.

RQ1: What are collegiate flight students' perceptions regarding mental health disclosure based on the current aeromedical process?

What were the primary conclusions drawn from the analyzed qualitative and quantitative data? Most prominent was the feeling that there is a perceived benefit to not disclosing or ignoring mental health and fitness issues; students are aware of mental health and the impact it has in the cockpit; their mental health is impacted by several factors, and the current FAA medical certification process could be improved. One of the collegiate flight students participating in this study directed their concern to the researchers, "Even though this research data is protected and as you [researchers] said in your email that all pilots are highly uncomfortable when talking about mental health due to the fear of the FAA getting involved; no matter the protections it is almost like you can trust no one about this topic."

RQ2: Do collegiate flight students view disclosing mental health struggles as having a negative impact upon their careers?

So why do collegiate aviators believe there is a benefit to dishonesty? Similarly, what is the impact of being truthful, even when there may be reasons not to be? Participating students indicated that it is dangerous to hide mental health disorders, yet 68% believe the way the FAA aeromedical standards are presently written encourages dishonesty. Thirty-eight percent of participants are aware of someone who has been dishonest during this process, noting that a rationale for doing so is the consequences of being truthful. Seventy-one percent thought that by telling their AME that they were depressed or anxious, then they would no longer be able to fly. One of the participating flight schools stated, "Even though I'm mentally OK, I would NEVER see a psychologist on the very small chance they would diagnose me with something that could be used against me from getting my medical." Eighty-five percent of the students believed their flying careers were tied to their ability to receive a medical at the time of their examination (no deferral to the FAA for further review).

RQ3: What strategies do collegiate flight students use to manage their mental health and what are these strategies' effectiveness?

What are some of the drivers, both negative and positive, for mental health within this population? How can industry standards be revised to be more supportive of pilots with mental health conditions? Each participant noted which methods they use to help manage their own mental health. Employed techniques included exercise, spending time with loved ones, and using proper time management, as a few examples. Many participants stated they use multiple of the techniques listed, as well as others. Fifty-nine percent of students disagreed or were neutral to the Likert Scale statement their collegiate flight program had adequate resources to support their mental health. Eighty-four percent of students agreed the aeromedical standards should be revised, with 69% feeling that the standards, as they are written, are either uncertain or subjective – in relation to mental health disorders.

Based on the findings of the survey, in addition to conclusions drawn from the research data, the researchers advise the following recommendations. First, the majority (71%) of students recognized the connection between mental health and their ability to fly. As a result of the correlation between one's mental health and other aspects of well-being in their flying careers, flight students should begin or continue creating healthy habits. As it pertains to mental health, students should foster habits that allow them to manage their current related issues, as well as ones that may occur in the future.

Secondly, by knowing what can happen when mental health is stigmatized or ignored amongst its student population, collegiate flight programs should begin or continue, fostering conversations surrounding mental health and collegiate aviation. As evidenced by a flight student who stated, "Some flight instructors need to have more of a teaching attitude, it is not the actual flying that jacks my mental health – it is the people at my flight school." And another student added, "The school that I go to lacks awareness of a student's mental situation and seems as they do not care about me, which does not help with the situation that I face flight training." Each program should conduct research with their own students to determine how their students' perceptions vary from the sample population studied in this research. From these conversations and research, collegiate flight programs and their associated universities can create resources to address these issues, as well as anticipate potential mental health related problems connected with flight training prior to them occurring. As one flight student stated, "I love flying and aviation, but sometimes it can be a lot. I feel there is no one who cares or is safe to just vent all my feelings to. I cannot talk to a therapist at my school because they do not know what I am talking about or try to diagnose me with something that will cause me to lose my medical." And another student added, "Prior to this semester I struggled with depression and anxiety but have been scared to see a university counselor since I do not want to be grounded and delay my flight training. I would love to get help and support, but I am not willing to risk my future as a pilot when I can find different ways to handle my anxiety and depression with meditation and journaling."

RQ4: Do collegiate flight students feel there is a tangible benefit to pilots and the public if the current first-class medical certification standards related to mental health aspects are revised?

Last, the findings of this research study should be discussed among various governmental and industry-trade organizations. These organizations can use the examined literature and the results derived from student perceptions to review and potentially revise existing regulations surrounding mental health, flying, and aeromedical certification. A common theme from the students' comments was they believe the current certification process is punitive to pilots. As stated by one of the student pilots, "I strongly believe that if the FAA made attention-deficit/hyperactivity disorder (ADHD) medication, SSRIs, anti-anxiety medication, and other medications non-disqualifying we would see a marked decrease in instances of anxiety and depression in flight students." So, lawmakers and others should be mindful of that aspect when reviewing this research, as well as other examples that showcase the current state of certifications and regulations surrounding mental health and collegiate aviation.

Study Beneficiaries

Degree-seeking flight students and university flight programs are the primary beneficiaries of this study as its findings are directly related to each party. The data from this study contributes to existing research surrounding mental health and aviation, including the limited amount of information that is specifically focused on this unique segment of the industry. These results are useful context for decision makers to understand issues related to the future aviation workforce. On a concluding note, a participating flight student commented, "It is good that there has been so much noise about mental health in aviation lately, considering it can be such a taboo topic in a field where we are expected to be 100% physically and mentally fit." And another student added, "I hope this increased discourse around mental health will start to shed light towards people in the flying community stuck in the dark of their own minds."

Recommendations for Further Research

Further research studies are needed to determine whether the current mental health standards for aeromedical certification are a barrier to entry or a barrier for student pilots in completing their bachelor's degrees related to flight. Additionally, an understanding of whether mental health issues associated with collegiate flight are a contributing factor for undergraduate students who underperform in coursework, fail to graduate or are delayed from their original plan of study. Also, a further study is recommended to determine if collegiate flight students suffer from anxiety and depression at a differing rate than the non-flying collegiate student population. Additionally, this study should attempt to understand the causes for anxiety and depression within flight programs, including whether the symptoms are situational and whether they are caused by factors that could be controlled if known. Last, how well do collegiate flight programs support their flight student's mental health, and what strategies, if any, are programs employing to support their students? Further studies could focus on flight programs that have already implemented mental health awareness classes, peer-to-peer support groups, and other mental health management methods, in addition to airlines and other pilot-focused groups that have incorporated successful mental health support strategies into their own flight operations.

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Comparison of Taxi-in and Taxi-out Times by Airport Hub Classification and Number of Hot Spots

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Taxi time has been identified as a significant factor that may affect airport capacity, congestion, fuel burn, and emissions. Reducing taxi time at airports may contribute to increasing airport efficiency and capacity, and reducing fuel consumption and emissions. In this paper, average quarter-hour taxi-time data from a sample of 33 U.S. airports was analyzed to explore the difference between taxi-out time and taxi-in time. Using parametric and non-parametric statistical tests, this research found that the mean and median taxi-out time was significantly different from the mean and median taxi-in time for each of the three airport hub classifications (small, medium, large) and each of the six numbers of airport hot spots (0, 1, 2, 3, 4, 5). The results of this research may provide a better understanding of taxi time at small, medium, and large hubs airports with hot spots. The results may be useful to airport managers and decision makers to improve airport efficiency when faced with competing airport improvement initiatives or projects.

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Introduction

The U.S. National Airspace System (NAS) forecasts show an annual enplanement growth rate of 1.7% to 3.5% in the future (FAA, 2023). Due to airport configurations and limitations of land use, some airports cannot expand their aircraft operating area as a way to meet the increasing demand. This limited operating area may lead to longer taxi time, congestion, flight delays, cancellations, and increased aircraft emissions at airports. With increased operations and constrained airport landside space, aircraft taxiway routing and queuing time may increase. Reducing taxi time at airports contributes to increasing airport efficiency and capacity, and reducing fuel consumption and emissions. Previously, multiple factors have been studied for their potential effects on taxi time, such as weather conditions, number of flights, airport runway configurations, taxi distance, and type of operations. The Federal Aviation Administration (FAA, 2022 March) identifies areas on airport diagrams that need attention by pilots, ground vehicle drivers, or air traffic controllers due to the potential for collisions or incursions because of previous incidents or potential risks of incidents. However, there is limited research on the relationships between airport taxi time, airport hub classification, and the number of airport hot spots. This paper contains a comparison of taxi-out to taxi-in time for each of the three airport hub classifications (small, medium, and large) and for each of the six numbers of hot spots (0,1,2,3,4,5) on airports.

This research focuses on exploring whether taxi-out time is equal to taxi-in time at airports for each of the three hub classifications (S/M/L) and for each of the six numbers of hot spots (0,1,2,3,4,5). In this study, the 11 busiest airports (by number of total operations) from each of the three National Plan of Integrated Airport System (NPIAS) hub classification categories (Small, Medium, Large) (FAA, 2022 October) were selected from the Aviation System Performance Metrics (ASPM) dataset (FAA, n.d.-a). The 20 busiest days (by number of daily operations) were selected for each of the 33 airports and the average quarter-hour taxi-in and taxi-out time were sampled from the ASPM dataset (FAA, n.d.-a) between 06:00 AM to 10:00 PM from May 01, 2022, to September 30, 2022, for each of the 33 airports. Statistical (parametric and non-parametric) and graphical analyses were used to answer research questions related to comparing taxi-out and taxi-in time. Minitab® and IBM® SPSS® are commercially available statistical packages that were used for statistical and graphical tests.

By exploring the difference between airport taxi-out and taxi-in time for each of the three hub classifications and for each of the six hot spot numbers, the research aims to identify factors affecting taxi operations. Reducing aircraft taxi time may contribute to reducing aircraft emissions, fuel burn, and improving airport capacity. The results of this research may be useful to airport managers and decision makers to improve airport efficiency when faced with competing airport improvement initiatives or projects.

Background and Literature Review

The FAA ASPM dataset describes taxi-in time as the time difference between Wheels On time, Gate In time, and taxi-out time as the time difference between Gate Out time and Wheels Off time (FAA, n.d.-b). Aircraft taxi operations and taxi time length have several impacts on air travel, such as flight delays, congestion, excessive fuel burn, and aircraft emissions. The estimated total cost of flight delays in U.S. airports was 33 billion dollars in 2019, with a rise of 9% compared to 2018 (FAA, n.d.-c). A study found that a majority (60%) of the total flight delays at U.S. major airports were related to taxi-out delays (Laskey et al., 2006).

Longer taxi time contributes to increased engine exhaust emissions, brake dust and tire deposits, and congestion at airports. Due to the limitations of land use and airport configurations, some airports cannot expand their operating area to meet the increasing demand; therefore, expanding the capacity of airports may be restricted. For example, New York LaGuardia (LGA) airport is constrained by the limited space for new runways and ramps (Burgain, 2010). With the growing air traffic flow in the U.S., airports may expect more congestion and longer taxi time, along with associated flight delays, congestion, excessive fuel burn, and aircraft emissions.

When aircraft engines are operating, pollutants are emitted at the airport and surrounding areas. Aircraft operating at airports are significant sources of pollutant emissions that can impact humans (Dissanayaka et al., 2023). The carbon dioxide and nitrogen oxides generated by aviation operations around airports are expected to increase significantly by 2025 and beyond (Burgain, 2010). Aircraft that have to stop and go while taxiing contribute to approximately 18% of the fuel consumption, representing an increase of around 35% compared to the fuel consumption during uninterrupted aircraft operations (Nikoleris et al., 2011). The cost of fuel consumed during taxi operations has a major impact on airline operating costs (Murner, 2012). A better understanding of taxi time and a reduction in taxi time may help save fuel, improve the financial health of airlines, and reduce the impacts on humans and the environment.

Investigating the factors affecting taxi time and constructing taxi time models may reveal patterns of taxi operations that may be used to reduce taxi time and, therefore, mitigate congestion and reduce fuel burn. By reducing total taxi time, airport operation efficiency may be improved, and aircraft emissions may be reduced (Atkin et al., 2010; Atkin et al., 2011). When taxi time is shorter at airports, there is the potential for expanding the capacity of airports while not expanding the aircraft movement area. Less congestion and shorter taxi time contribute to less engine exhaust substances emitted at airports and surrounding areas. Identifying patterns in taxi-in and taxi-out time at airports may assist in reducing the operational costs for airports and airlines.

For statistical modeling and predicting airport taxi time, researchers have studied eleven factors as independent variables in the regression models that may affect taxi time at airports. These factors include weather conditions (Mirmohammadsadeghi et al., 2019; Park & Kim, 2023; Srivastava, 2011), number of flights (Balakrishna et al., 2010; Clewlow et al., 2010; Mirmohammadsadeghi et al., 2019; Park & Kim, 2023; Ravizza et al., 2013; Srivastava, 2011), airport runway configurations (Clewlow et al., 2010; Lordan et al., 2016; Mirmohammadsadeghi et al., 2019; Srivastava, 2011), taxi distance (Lee et al., 2015; Lee et al., 2016; Lordan et al., 2016; Ravizza et al., 2013; Srivastava, 2011), type of operations (Ravizza et al., 2013), taxi speed (Ravizza et al., 2013; Wang et al., 2021), number of turns during taxi operation (Wang et al., 2021), aircraft weight (Lee et al., 2016; Wang et al., 2021), time of the day (Balakrishna et al., 2010; Lee et al., 2016), terminal concourse and gates (Lee et al., 2015; Lee et al., 2016), and aircraft type (Wang et al., 2021). Studies have shown that weather conditions, especially wind, air pressure, and precipitation (Park & Kim, 2023), can significantly affect taxi-in time and taxi-out time at airports (Srivastava, 2011). Another study showed that including weather in the runway capacity simulation model brought an enhancement to the accuracy of the simulation results (Mirmohammadsadeghi et al., 2019). Studies have shown that an increasing the number of flights can result in longer taxi time (Balakrishna et al., 2010; Mirmohammadsadeghi et al., 2019; Park & Kim, 2023; Ravizza et al., 2013; Srivastava, 2011) and that the number of arrival flights is significantly correlated to taxi-out time (Clewlow et al., 2010). When the airport runway configuration has more interactions between arrivals and departure aircraft (intersections or conflicts), the number of arrival flights has a more significant impact on taxi-out time (Clewlow et al., 2010). Researchers have concluded that taxi distance (Lee et al., 2015; Lee et al., 2016) and taxi speed (Wang et al., 2021) significantly contribute to taxi time. In this paper, two potential factors that may affect taxi time at airports are explored – airport hub classification and number of hot spots.

Airport hub classification may be studied as a broad indicator of the number of annual enplanements, number of flights, and size of land area or movement area. Previous studies (Balakrishna et al., 2010; Clewlow et al., 2010; Mirmohammadsadeghi et al., 2019; Park & Kim, 2023; Ravizza et al., 2013; Srivastava, 2011) have studied the number of flights as a factor when analyzing taxi time or developing taxi time prediction models. The number of flights may be affected by the airport's physical size, the number of enplanements, and the aircraft types operating at that airport. In terms of hub classifications, the FAA categorizes publicly owned airports with a minimum of 2,500 annual enplanements as commercial service airports (FAA, n.d.-d). These airports are further divided into Large Hub, Medium Hub, Small Hub, and Non hub airports based on the number of enplanements (FAA, n.d.-d). The FAA defines hub airports as:

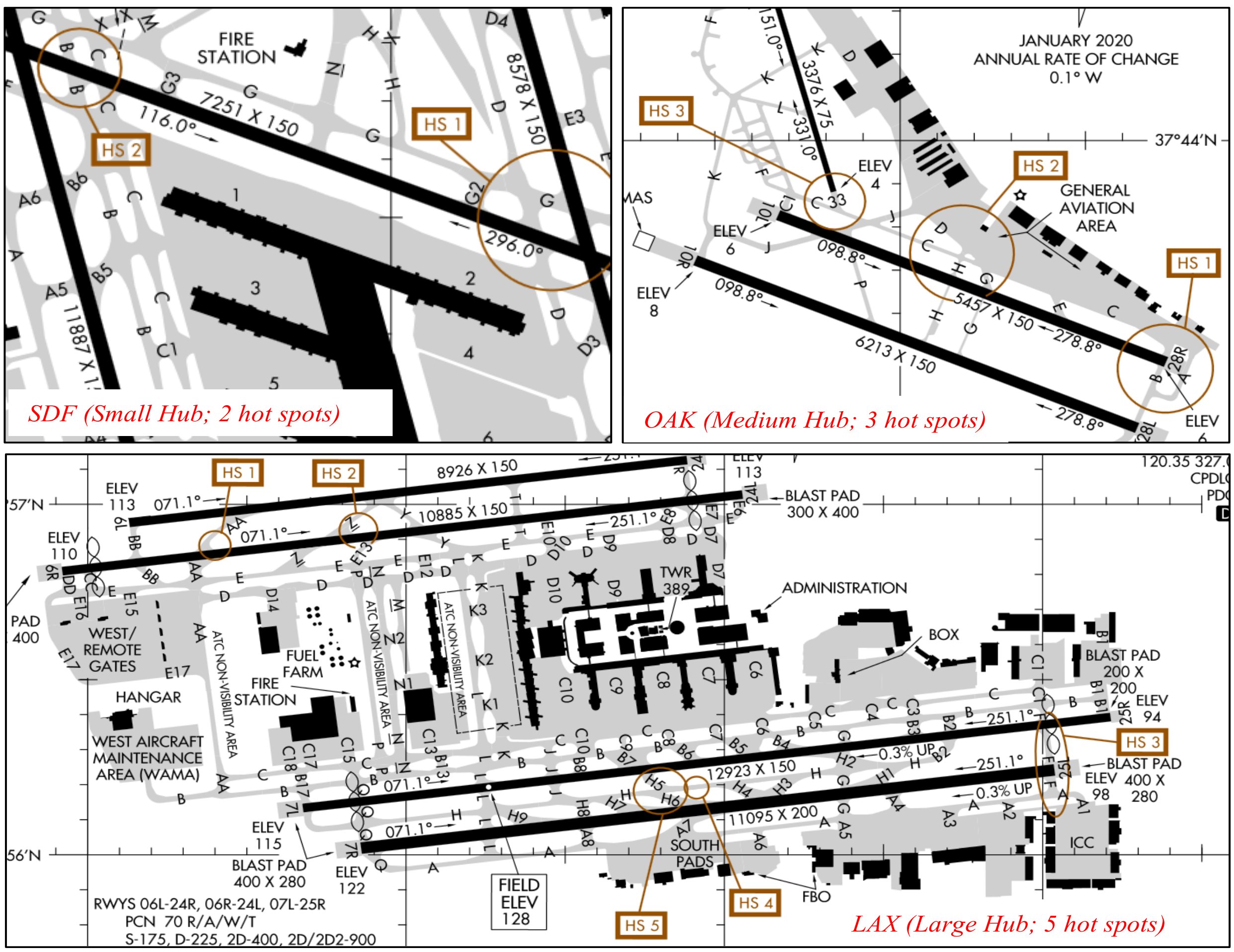
- Large Hub airports as those that receive 1% or more of the U.S. annual commercial enplanements,
- Medium Hub airports as those that receive 0.25% to 1% of the annual enplanements,
- Small Hub airports as those that receive 0.05% to 0.25% of the annual enplanements, and
- Non-hub airports are those that receive less than 0.05% but more than 10,000 of the annual enplanements (FAA, n.d.-d).

Therefore, in this research, airport hub classifications are considered as a broad indicator of the size of the airport. Annual enplanements are associated with the number of flights. This paper focuses on small, medium, and large hub airports as classified by the FAA in the National Plan of Integrated Airport System (NPIAS) report (FAA, 2022 October).

Per the FAA, a hot spot is a location in an airport movement area with a history of collision or runway incursion, therefore needing attention by the pilots or air traffic controllers (FAA, 2022 March). The presence of hot spots may influence pilots to slow down or even stop for safety reasons, affecting the aircraft taxi time. According to the FAA, "hot spots are complex or confusing taxiway/taxiway or taxi/runway intersections" (FAA, 2022 March, para. 2); the criteria for determining hot spots in airports include, but are not limited to, "airport layout, traffic flow, airport marking, signage and lighting, situational awareness, and training" (FAA, 2022 March, para. 2). Researchers have studied airport complexity factors such as the number of intersections (Clewlow et al., 2010), airport layout (Lordan et al, 2016), and traffic flow (Balakrishna et al., 2010; Park & Kim, 2023; Srivastava, 2011) that may contribute to taxi time at airports. Given that these factors are considered when determining airport hot spots, the number of hot spots in airports may be studied as a simplified and broad indicator of airport configuration complexity and the number of complex or confusing intersections in analyzing taxi time. Therefore, this research includes the number of hot spots on airport diagrams as an independent factor to study its effects on taxi time at small, medium, and large hub airports. Airport hot spots are marked on the FAA airport diagrams, and the hot spot data is also published in the Digital Chart Supplement (d-CS) by the FAA (FAA, 2022 March). Figure 1 shows examples of hot spots on SDF (small hub), OAK (medium hub), and LAX (large hub) airport diagrams (FAA, 2022 May).

Figure 1

Examples of Hot Spots on SDF, OAK, and LAX Airport Diagrams



Note. The images are adapted from the FAA Airport Diagrams (26 JAN 2023 to 23 FEB 2023) of SDF, OAK, and LAX airports (FAA, 2022 May).

Gupta et al. (2023) studied the effect of airport hub classification and the number of hot spots on taxi time by conducting one-way ANOVA parametric and Kruskal-Wallis non-parametric tests. Separate tests were conducted for taxi-out time and taxi-in time as response variables, and airport hub classifications (3 levels – S/M/L) and the number of hot spots (6 levels – 0, 1, 2, 3, 4, 5) as factors. The study found that taxi-out and taxi-in time each varies by airport hub classification, i.e., taxi-out time was different for small, medium, and large hubs, and taxi-in time was different for small, medium, and large hubs. It also found that taxi-out time at airports with (0, 3, 4, 5) hot spots was different from the taxi-out time at airports with (1, 2) hot spots. Taxi-in time at airports with (1, 2, 3, 4) hot spots was different from the taxi-in time at airports with (0, 5) hot spots (Gupta et al., 2023). However, Gupta et al. (2023) did not test if the mean of taxi-out time equals the mean of taxi-in time for airports with the same hub classification and for airports with the same number of hot spots.

This paper builds upon the results of Gupta et al. (2023) to further explore taxi time and compare taxi-out time with taxi-in time. In this study, the difference between taxi-out time and taxi-in time is analyzed in 1) a combined sample of the same 33 airports, 2) three separate tests for each airport hub classification (S/M/L), and 3) six separate tests for each number of hot spots at airports (0, 1, 2, 3, 4, 5). Specifically, this research aims to answer three research questions:

RQ1: Is taxi-out time equal to taxi-in time for airports (without considering hubs or hot spots)?
RQ2: Is taxi-out time equal to the taxi-in time for each of the three airport hub classifications?
RQ3: Is taxi-out time equal to the taxi-in time for each of the six numbers of hot spots?
RQ4: Is taxi-out time equal to the taxi-in time for each combination of the three airport hub classifications and the six numbers of spots?

Methodology

This section presents the data sources, collection, consolidation, and data analysis used to answer the research questions.

Data Sources: For this paper, the researchers collected airport-related data from ASPM for airport operations data (FAA, n.d.-e) and for taxi time (FAA, n.d.-f), NPIAS 2023-2027 for hub classification (FAA, 2022 October), and FAA airport diagrams for hot spots (FAA, 2022 May).

Data Collection: The researchers used the ASPM (FAA, n.d.-a) dataset for the list of airports, dates, and the number of daily Departures and Arrivals for Metric Computation for the selected timeframe between 05/01/2022 and 09/31/2022 to capture a busy travel season. The hub classification of airports was found from the NPIAS 2023-2027 (FAA, 2022 October) dataset (*Appendix A: List of NPIAS Airports* (FAA, 2022 October)). The ASPM dataset and the NPIAS dataset were crossmatched to find the hub classification (Small/Medium/Large) for each of the 77 ASPM airports.

Based on the total number of Departures and Arrivals from 05/01/2022 to 09/30/2022, the researchers formed a sample of 33 airports by selecting the 11 busiest airports from each of the three hub classifications (S/M/L). Researchers selected the 20 busiest days for each of the 33 airports based on the total daily number of departures and arrivals at each airport. Note: The dates of the busiest days may differ among the airports. The researchers collected quarter-hour taxi-time data between 6:00 AM and 10:00 PM (local time) from the ASPM dataset (FAA, n.d.-a) for each of the 20 busiest days for each of the 33 airports. The FAA Airport Diagrams

(01/26/2023 to 02/23/2023) (FAA, 2022 May) were used to obtain the number of hot spots at each of the 33 sampled airports.

Data Consolidation: Data from 33 airports, obtained from the ASPM dataset, NPIAS dataset, and FAA airport diagrams, were combined into a single spreadsheet. Tabulated data for each airport included quarter-hour taxi-in and taxi-out time between 6:00 AM and 10:00 PM (local time) for the 20 busiest days, departures and arrivals in each quarter, NPIAS hub classification, and the number of hot spots at airports. This consolidated data repeats that of Gupta et al. (2023), who conducted ANOVA on taxi-out and taxi-in time (as separate response variables), and hub classification and the number of hot spots as factors. This paper focuses on comparing taxi-out time with taxi-in time for each of the three hub classifications and six numbers of hot spots. In total, 39,268 observations were collected across ten fields, as shown in a snippet of the spreadsheet in Figure 2.

Figure 2

Sample of Consolidated Data Table Using Three Sources of Data

ASPM Dataset (FAA, n.d.-f)								**NPIAS 2023-2027** (FAA, 2022, Oct)	**FAA Airport Diagrams** (FAA, 2022, May)
Facility	**Date**	**Quarter**	**Hour**	**Departures For Metric Computation**	**Average taxi out time**	**Arrivals For Metric Computation**	**Average taxi in time**	**NPIAS Hub Classification**	**Number of Hot Spots**
PVD	09/01/2022	3	10	3	8.67	0	0	S	5
PVD	09/01/2022	3	12	3	28	1	10	S	5
PVD	09/01/2022	3	13	2	11.5	1	5	S	5
PVD	09/01/2022	3	14	2	9.5	2	5.5	S	5
ANC	8/24/2022	4	8	0	0	3	5	M	2
ANC	8/24/2022	4	9	3	11.33	1	6	M	2
ANC	8/24/2022	4	11	4	15.75	3	9.67	M	2
ANC	8/24/2022	4	12	4	12.75	3	6.33	M	2
CLT	6/6/2022	1	9	35	22.66	4	6.75	L	3
CLT	6/6/2022	1	10	3	14	30	12.6	L	3
CLT	6/6/2022	1	11	38	22.18	2	5.5	L	3
CLT	6/6/2022	1	12	5	15	20	11.85	L	3

Note. The data in this figure has the same headings as Gupta et al. (2023)

Data Analysis: To answer the three research questions, a parametric test (Paired Samples *t* Test) and a non-parametric test (Wilcoxon Signed Rank Test) were selected to compare means and medians for quarter-hour taxi-out and taxi-in time. The researchers identified outliers and unequal variance in the samples during data processing and, therefore, approached the research questions using both parametric and non-parametric methods to analyze the mean and median quarter-hour taxi time. The researchers used commercially available statistical packages (Minitab® and IBM® SPSS®) to analyze and visualize the data. There were zeros in the taxi-time data for the sampled airports in each of the three hub classifications. Zeros in taxi-in data represent no arrival operations during that quarter hour; likewise, zeros in taxi-out data represent no departures during that quarter hour. The number of zeros in taxi-in and taxi-out data was highest for small hub airports (taxi-out: 3,195 zeros; taxi-in: 3,318 zeros), followed by medium hub (taxi-out: 994 zeros; taxi-in: 999 zeros) and large hub airports (taxi-out: 45 zeros; taxi-in: 41

zeros). In this paper, zeros have been removed from the data, i.e., any quarter-hour taxi time paired with either taxi-out or taxi-in time reported as zero was removed from the data. Therefore, the taxi time used in the analysis is based on the condition that there was at least one departure and one arrival at the airport in that specific quarter-hour.

For RQ1, taxi-out and taxi-in time were treated as a combined single-paired sample without considering the hub classifications or hot spots. For RQ2, the data was segregated according to hub classifications (S/M/L) to test if taxi-out and taxi-in time were equal for each of the three NPIAS hub classifications. Individual tests were conducted to compare mean and median taxi time for small, medium, and large hub airports. For RQ3, the data was segregated according to the number of hot spots (0, 1, 2, 3, 4, 5) to test if taxi-out and taxi-in time were equal for airports with different numbers of hot spots. Individual tests were conducted to compare mean and median taxi time for 0, 1, 2, 3, 4, and 5 hot spots in airports. For RQ4, the data was segregated according to each of the airport hub classifications and hot spot combinations (for example, small hub airports with four hot spots, medium hub airports with one hot spot, large hub airports with three hot spots, etc.). A total of 16 combinations were segregated from the sample data. For each combination, paired *t*-tests and Wilcoxon Signed Rank tests were used to compare taxi-out time with taxi-in time. Table 1 lists the statistical tests, the null and alternate hypotheses, and the data samples.

Table 1
Statistical Tests, Hypotheses, and Data Samples to Answer the Research Questions

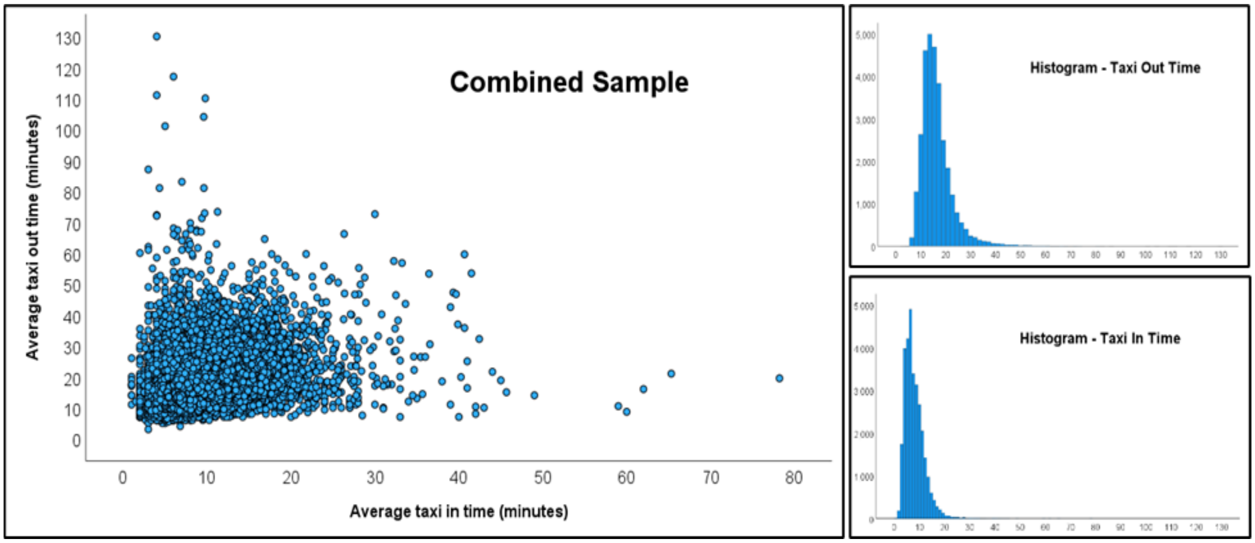
Test	Hypotheses	Data Sample
Paired Samples *t*-test	H_o: $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in} = 0$ H_a: $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in} \neq 0$	RQ1: combined sample; RQ2: data segregated by hub classification; RQ3: data segregated by number of hot spots; RQ4: data segregated by each combination of hub classification and number of hot spots
Wilcoxon Signed Rank Test	H_o: $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in} = 0$ H_a: $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in} \neq 0$	

Results

This section presents the results of the statistical tests used to answer research questions. The researchers compared the taxi-in and taxi-out time as a combined sample at the three NPIAS hub classifications (S/M/L) and across the different numbers of hot spots at airports. Results of statistical tests and charts are shown within each research question.

RQ1. Is taxi-out time equal to taxi-in time for airports (without considering hubs or hot spots)? To answer this question, taxi-in time and taxi-out time were treated as a combined single paired sample without considering the hub classifications or number of hot spots. Figure 3 shows the scatter plot and histograms for taxi-out and taxi-in time. Table 2 presents the consolidated results of the statistical tests.

Figure 3
Scatter Plot and Histograms for Taxi-Out and Taxi-In Time from All 33 Airports



Note. In the scatterplots, the scales for the x-axis (zero to 80 minutes) and for the y-axis (zero to 120 minutes) are different. Zeros have been removed from the taxi-time data.

The sample mean and median taxi-out time (M = 16.32 minutes, Mdn = 15.09 minutes) was greater than the sample mean and median taxi-in time (M = 8.00 minutes, Mdn = 7.22 minutes) for the sampled airports. The sample variation in taxi-out time (SD = 6.35 minutes) was greater than the sample variation of taxi-in time (SD = 4.00 minutes).

Paired *t*-test: Using the data collected, an alpha of 0.05, and the paired samples *t*-test to compare means, the researchers *rejected the null hypothesis* (p<0.001) that the population mean taxi-out time was equal to the population mean taxi-in time at airports. The 95% confidence interval for the difference $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in}$ was (8.25, 8.39) minutes.

Wilcoxon Signed Rank Test: Using the data collected, an alpha of 0.05, and the Wilcoxon Signed Rank Test to compare medians, the researchers *rejected the null hypotheses* (p<0.001) that the population median taxi-out time was equal to the population median taxi-in time. The 95% confidence interval for the median difference $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in}$ was (7.78, 7.89) minutes.

Table 2
Consolidated Results of RQ1 (taxi-out vs. taxi-in time for the combined sample)

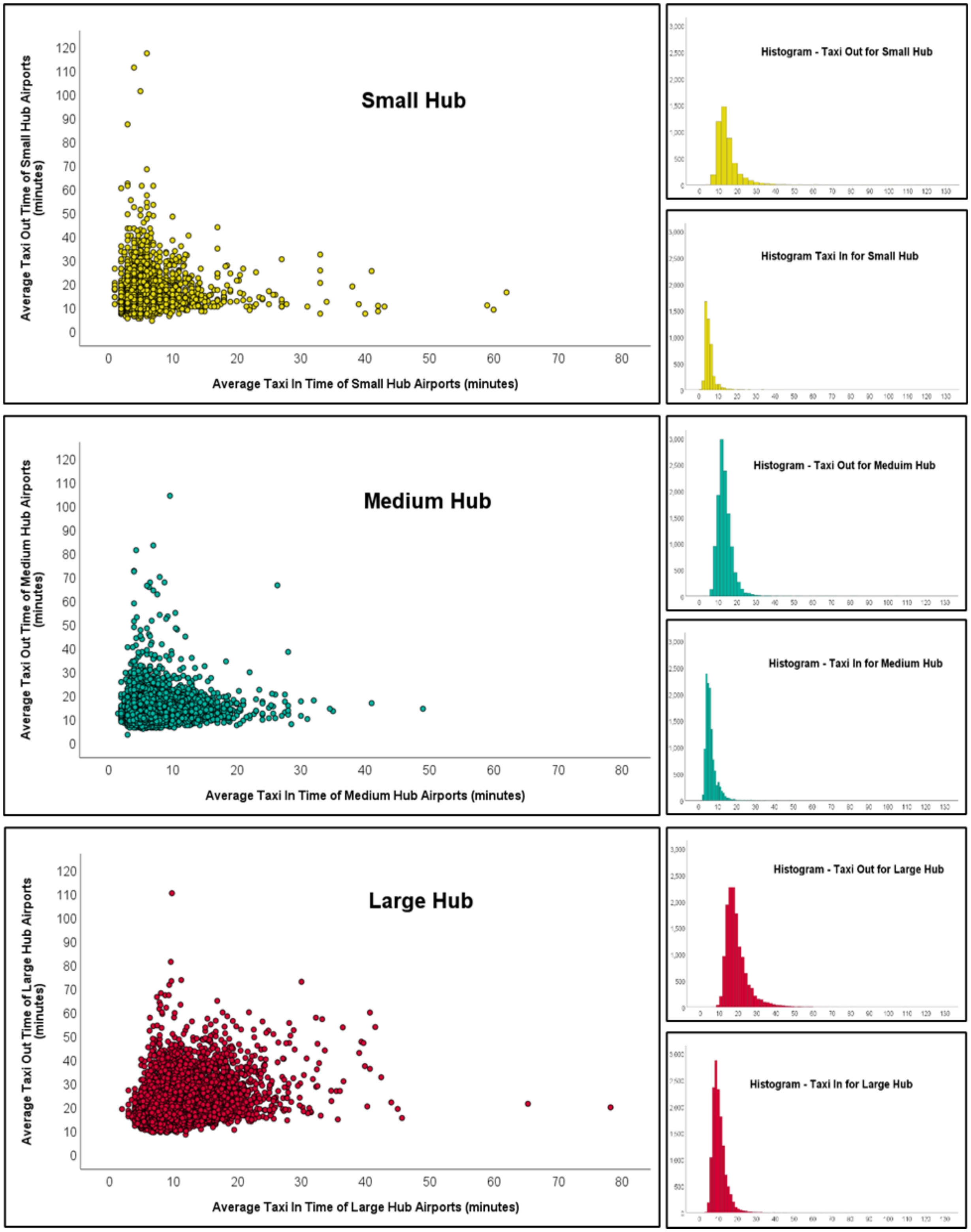
Average Taxi Time	Descriptive Statistics (all times are in minutes)				Difference Tests for Mean and Median (alpha = 0.05) (all times are in minutes)						
					Paired *t*-test $H_o: \mu_{taxi\text{-}out} - \mu_{taxi\text{-}in} = 0$ $H_a: \mu_{taxi\text{-}out} - \mu_{taxi\text{-}in} \neq 0$				Wilcoxon Signed Rank Test $H_o: \eta_{taxi\text{-}out} - \eta_{taxi\text{-}in} = 0$ $H_a: \eta_{taxi\text{-}out} - \eta_{taxi\text{-}in} \neq 0$		
	n	Mean time (*M*)	Median time (*Mdn*)	*SD*	Mean time (*M*)	*SD*	95% *CI* for mean diff	*p*	Median	95% confidence achieved	*p*
Taxi-out	30,676	16.32	15.09	6.35	8.32	6.11	(8.25, 8.39)	<0.001	7.39	(7.78, 7.89)	<0.001
Taxi-in	30,676	8.00	7.22	4.00							

RQ2. Is taxi-out time equal to taxi-in time for each of the three airport hub classifications?
This question was answered individually for small, medium, and large hub airport data. Paired *t*-test and Wilcoxon Signed Rank test were conducted for each of the three hub classifications. Figure 4 shows scatter plots and histograms for taxi-out and taxi-in time at each of the three airport hub classifications. Table 3 presents the consolidated results of the statistical tests.

The sample mean and median taxi-out time (minutes) for large hub airports (*M* = 19.30 minutes, *Mdn* = 17.78 minutes) were longer than that of medium hubs airports (*M* = 13.46 minutes, *Mdn* = 12.75 minutes), which were longer than small hub airports (*M* = 14.75 minutes, *Mdn* = 13.00 minutes). The sample mean and median taxi-in time for large hub airports (*M* = 10.32 minutes, *Mdn* = 9.63 minutes) were longer than that of medium hub airports (*M* = 6.29 minutes, *Mdn* = 5.50 minutes), which were longer than small hub airports (*M* = 5.49 minutes, *Mdn* = 5.00 minutes). Small hub airports were found to have the highest sample variation in taxi-out (*SD* = 6.62 minutes) time. Large hub airports were found to have the highest sample variation in taxi-in (*SD* = 3.49 minutes) time.

Figure 4

Scatter Plot and Histograms for Taxi Time at Small, Medium, and Large Hub Airports



Note. In the scatterplots, the scales for the x-axis (zero to 80 minutes) and for the y-axis (zero to 120 minutes) are different. Zeros have been removed from the taxi-time data.

Paired *t*-test: Using the data collected, an alpha of 0.05, and the paired-t test to compare means, the researchers *rejected the null hypotheses* (p<0.001) that the population mean taxi-out time was equal to the population mean taxi-in time at each of the airport hub classifications (S/M/L). The sample mean difference in the taxi-out and taxi-in time was found for small hubs (9.26 minutes), medium hubs (7.17 minutes), and large hub airports (8.89 minutes). The 95% confidence interval for the mean difference $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in}$ was (9.05, 9.47) minutes at small hub airports, (7.08, 7.26) minutes at medium hub airports, and (8.88, 9.08) minutes at large hub airports.

Wilcoxon Signed Rank Test: Using the data collected, an alpha of 0.05, and the Wilcoxon Signed Rank Test to compare medians, the researchers *rejected the null hypotheses* (p<0.001) that the population median taxi-out time was equal to the population median taxi-in time at each of the airport hub classifications (S/M/L). The sample median difference in the taxi-out and taxi-in time was found for small hubs (8.67 minutes), medium hubs (7.00 minutes), and large hub airports (8.36 minutes). The 95% confidence interval for the median difference $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in}$ was (8.50, 8.80) minutes at small hub airports, (6.92, 7.06) minutes at medium hub airports, and (8.28, 8.45) minutes at large hub airports.

Table 3
Statistical results of RQ2 (taxi-out vs. taxi-in time by airport hub classifications)

Airport Hub Classification		Descriptive Statistics[a] (all times are in minutes)				Difference Tests for Mean and Median (alpha = 0.05) (all times are in minutes)							
						Paired *t*-test H₀: $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in} = 0$ Hₐ: $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in} \neq 0$				**Wilcoxon Signed Rank Test** H₀: $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in} = 0$ Hₐ: $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in} \neq 0$			
		n	Mean time (*M*)	Median time (*Mdn*)	*SD*	Mean time (*M*)	*SD*	95% *CI* for mean diff	*p*	Median	95% confidence achieved	*p*
S	Taxi out	4,707	14.75	13.00	6.62	9.26	7.35	(9.05, 9.47)	<0.001	8.67	(8.50, 8.80)	<0.001
	Taxi in	4,707	5.49	5.00	3.48							
M	Taxi out	11,977	13.46	12.75	4.50	7.17	5.23	(7.08, 7.26)	<0.001	7.00	(6.92, 7.06)	<0.001
	Taxi in	11,977	6.29	5.50	2.97							
L	Taxi out	13,992	19.30	17.78	6.30	8.89	6.21	(8.88, 9.08)	<0.001	8.36	(8.28, 8.45)	<0.001
	Taxi in	13,992	10.32	9.63	3.49							

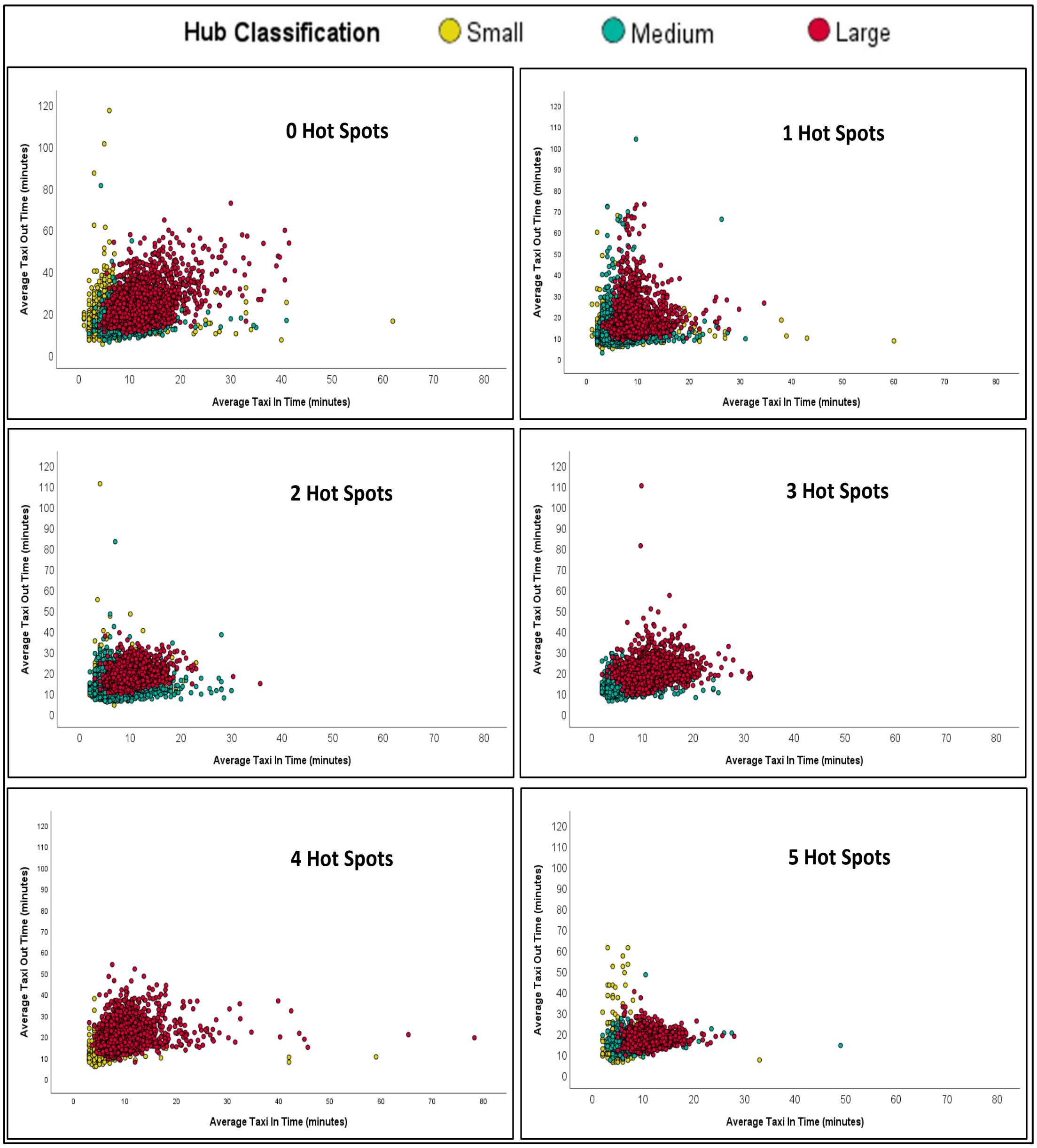
Note. [a]Descriptive statistics are from Gupta et al. (2023). The sample size *n* represents the number of all quarter-hours with at least one departure and one arrival, i.e., zeros have been removed from the taxi-time data.

RQ3. Is taxi-out time equal to taxi-in time for each of the six numbers of hot spots? This question was answered individually for each number of hot spots (0, 1, 2, 3, 4, 5). Paired *t*-test and Wilcoxon Signed Rank test were conducted for each of the hot spots. Figure 5 shows scatter plots and histograms for sample taxi-out and taxi-in time at each of the six hot spot numbers. Table 4 presents the consolidated results of the statistical tests.

Table 4 shows that the sample mean and median taxi-out time (minutes) were longer than the mean and median taxi-in time for airports with (0, 1, 2, 3, 4, and 5) hot spots. The sample mean and median taxi-out time were highest for airports with four hot spots (*M* = 19.23 minutes, *Mdn* = 18.24 minutes). The sample mean taxi-out time was lowest for airports with two hot spots (*M* = 14.87 minutes), and median taxi-out time was lowest for airports with one hot spot (*Mdn* = 13.22 minutes). The sample mean and median taxi-in time were highest for airports with 0 hot spot (*M* = 9.36 minutes, *Mdn* = 8.88 minutes) and lowest for airports with one hot spot (*M* = 6.62 minutes, *Mdn* = 6.00 minutes). Airports with 0 hot spots were found to have the highest sample variation in taxi-out (*SD* = 8.21 minutes) and taxi-in (*SD* = 4.93 minutes) time.

Figure 5

Scatter Plot of Taxi-Out vs Taxi-In Time at Airports with Different Number of Hot Spots



Note. In the sampled data, there were no small hub airports with three hot spots and no medium hub airports with four hot spots. In the scatterplots, the scales for the x-axis (zero to 80 minutes) and for the y-axis (zero to 120 minutes) are different. Zeros have been removed from the taxi-time data.

Paired *t*-test: Using the data collected, an alpha of 0.05, and the paired-t test to compare means, the researchers *rejected the null hypotheses* (p<0.001) that the population mean taxi-out time was equal to the population mean taxi-in time at airports with 0, 1, 2, 3, 4, and 5 hot spots. The minimum sample mean difference in the taxi-out and taxi-in time was 4.87 minutes at airports with two hot spots, and the maximum sample mean difference was 10.07 minutes at airports with four hot spots. The 95% confidence interval for the mean difference $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in}$ was (9.42, 9.84) minutes at airports with 0 hot spots, (8.10, 8.41) minutes at airports with one hot spot, (7.42, 7.64) minutes at airports with two hot spots, (7.47, 7.75) minutes at airports with three hot spots, (9.84, 10.30) minutes at airports with four hot spots, and (7.49, 7.87) minutes at airports with five hot spots.

Wilcoxon Signed Rank Test: Using the data collected, an alpha of 0.05, and the Wilcoxon Signed Rank Test to compare medians, the researchers *rejected the null hypotheses* (p<0.001) that the population median taxi-out time was equal to the population median taxi-in time at airports with 0, 1, 2, 3, 4, and 5 hot spots. The minimum sample median difference in the taxi-out and taxi-in time was 7.34 minutes and occurred at airports with three hot spots, and the maximum sample median difference was 9.86 minutes and occurred at airports with four hot spots. The 95% confidence interval for the median difference $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in}$ was (8.75, 9.10) minutes at airports with 0 hot spots, (7.41, 7.62) minutes at airports with one hot spot, (7.27, 7.46) minutes at airports with two hot spots, (7.22, 7.46) minutes at airports with three hot spots, (9.68, 10.04) minutes at airports with four hot spots, and (7.25, 7.51) minutes at airports with five hot spots.

Table 4
Statistical Results of RQ3 (taxi-out vs taxi-in time by different number of hot spots)

Number of Hot Spots		Descriptive Statistics[a] (all times are in minutes)				Difference Tests for Mean and Median (alpha = 0.05) (all times are in minutes)						
						Paired *t*-test H₀: $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in} = 0$ Hₐ: $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in} \neq 0$				Wilcoxon Signed Rank Test H₀: $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in} = 0$ Hₐ: $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in} \neq 0$		
		n	Mean time (*M*)	Median time (*Mdn*)	*SD*	Mean time (*M*)	*SD*	95% *CI* for mean diff	*p*	Median	95% confidence achieved	*p*
0	Taxi out	5,183	18.98	17.00	8.21	9.63	7.64	(9.42, 9.84)	<0.001	8.94	(8.75, 9.10)	<0.001
	Taxi in	5,183	9.36	8.88	4.93							
1	Taxi out	7,022	14.88	13.22	6.72	8.26	6.76	(8.10, 8.41)	<0.001	7.50	(7.41, 7.62)	<0.001
	Taxi in	7,022	6.62	6.00	3.36							
2	Taxi out	7,775	14.87	14.07	4.65	7.53	4.87	(7.42, 7.64)	<0.001	7.37	(7.27, 7.46)	<0.001
	Taxi in	7,775	7.34	6.69	3.09							
3	Taxi out	4,781	16.48	15.80	5.52	7.61	4.95	(7.47, 7.75)	<0.001	7.34	(7.22, 7.46)	<0.001
	Taxi in	4,781	8.87	8.50	4.27							
4	Taxi out	2,882	19.23	18.24	5.77	10.07	6.18	(9.84, 10.30)	<0.001	9.86	(9.68, 10.04)	<0.001
	Taxi in	2,882	9.16	8.30	4.38							
5	Taxi out	3,033	15.80	15.40	4.77	7.68	5.32	(7.49, 7.87)	<0.001	7.38	(7.25, 7.51)	<0.001
	Taxi in	3,033	8.12	7.63	3.46							

Note. [a]Descriptive statistics are from Gupta et al. (2023). The sample size *n* represents the number of all quarter-hours with at least one departure and one arrival, i.e., zeros have been removed from the taxi-time data.

RQ4. Is taxi-out time equal to taxi-in time for each of the three airport hub classifications and six of the numbers of hot spots? This question was answered individually for each combination of the airport hub classification and number of hot spots. The data was segregated into 16 groups. Paired *t*- tests and Wilcoxon Signed Rank tests were conducted for each of the groups. Table 5 presents the consolidated results of the statistical tests.

As shown in Table 5, the sample mean and median taxi-out time (minutes) were longer than the sample mean and median taxi-in time for each of the 16 combinations of hub classification and number of hot spots. The sample mean and median taxi-out time was highest for large hub airports with 0 hot spots (M = 22.29 minutes, Mdn = 19.50 minutes) and lowest for medium hub airports with one hot spot (M = 12.67 minutes, Mdn = 11.60 minutes). The sample mean taxi-in time was highest for large hub airports with 0 hot spots (M = 11.89 minutes), while the sample median taxi-in time was highest for large hub airports with three hot spots (Mdn = 11.4 minutes). The sample mean taxi-in time was lowest for small hub airports with five hotspots (M = 4.85 minutes), while the sample median taxi-in time was lowest for small hub airports with one hot spot (Mdn = 4.00 minutes). Small hub airports with five hot spots were found to have the highest sample variation in taxi-out time (SD = 8.62 minutes). Small hub airports with four hot spots were found to have the highest sample variation in taxi-in time (SD = 4.58 minutes), primarily due to a relatively lower sample size. The sample mean taxi-out time at small hub airports with 0, 1, or 2 hot spots were longer than the sample mean taxi-out time at median hub airports with 0, 1, or 2 hot spots. In addition, the researchers found some interesting and counter-intuitive results in the collected data sample. For example, as shown in Table 5, small and large hub airports with 0 hot spots were found to have the highest sample mean difference between taxi-out and taxi-in time as compared to their other combinations. While at medium hub airports, the highest sample mean difference between taxi-out and taxi-in time was at airports with five hotspots.

<u>Paired *t*-test:</u> Using the data collected, an alpha of 0.05, and the paired-t test to compare means, the researchers *rejected the null hypotheses* ($p<0.001$) that the population mean taxi-out time was equal to the population mean taxi-in time at each combination of small, medium, and large airports and 0, 1, 2, 3, 4, and 5 hot spots. The minimum sample mean difference in the taxi-out and taxi-in time was 5.71 minutes at medium hub airports with 0 hot spots, and the maximum sample mean difference was 10.97 minutes at small hub airports with 0 hot spots.

<u>Wilcoxon Signed Rank Test:</u> Using the data collected, an alpha of 0.05, and the Wilcoxon Signed Rank Test to compare medians, the researchers *rejected the null hypotheses* ($p<0.001$) that the population median taxi-out time was equal to the population median taxi-in time at small, medium, and large airports with 0, 1, 2, 3, 4, and 5 hot spots. The minimum sample median difference in the taxi-out and taxi-in time was 5.42 minutes at medium hub airports with 0 hot spots, and the maximum sample median difference was 10.33 minutes and occurred at small hub airports with 0 hot spots.

Table 5 *Statistical Results of RQ4 (taxi-out time vs. taxi-in time for each combination of hub classification and number of hot spots)*

Hub Classification	Number of Hot spots		Descriptive Statistics (all times are in minutes)				Difference Tests for Mean and Median (alpha = 0.05) (all times are in minutes)						
							Paired *t*-test H₀: $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in} = 0$ Hₐ: $\mu_{taxi\text{-}out} - \mu_{taxi\text{-}in} \neq 0$				Wilcoxon Signed Rank Test H₀: $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in} = 0$ Hₐ: $\eta_{taxi\text{-}out} - \eta_{taxi\text{-}in} \neq 0$		
			n	Mean time (*M*)	Median time (*Mdn*)	*SD*	Mean time (*M*)	*SD*	95% *CI* for mean diff	*p*	Median	95% confidence achieved	*p*
S	0	Taxi out	1595	16.50	15.00	7.52	10.97	8.16	(10.57, 11.37)	<0.001	10.33	(1.00, 10.60)	<0.001
		Taxi in	1595	5.53	5.00	3.81							
	1	Taxi out	1014	13.18	12.00	5.00	8.13	6.43	(7.73, 8.53)	<0.001	8.00	(7.67, 8.17)	<0.001
		Taxi in	1014	5.05	4.00	3.99							
	2	Taxi out	1208	14.23	13.33	5.31	8.22	5.73	(7.90, 8.54)	<0.001	7.88	(7.65, 8.09)	<0.001
		Taxi in	1208	6.01	5.50	2.55							
	4	Taxi out	323	13.42	12.75	4.48	7.57	6.54	(6.85, 8.28)	<0.001	7.50	(7.00, 8.00)	<0.001
		Taxi in	323	5.86	5.00	4.58							
	5	Taxi out	567	14.53	13.00	8.62	9.68	8.83	(8.95, 10.41)	<0.001	8.50	(8.00, 8.75)	<0.001
		Taxi in	567	4.85	4.50	1.98							
M	0	Taxi out	1044	14.73	14.00	4.99	5.71	6.29	(5.33, 6.09)	<0.001	5.42	(5.11, 5.75)	<0.001
		Taxi in	1044	9.02	8.00	3.86							
	1	Taxi out	3462	12.67	11.60	5.50	7.25	6.06	(7.04, 7.45)	<0.001	6.79	(6.67, 6.92)	<0.001
		Taxi in	3462	5.43	4.67	2.63							
	2	Taxi out	4017	13.61	13.00	4.23	7.09	5.09	(6.93, 7.25)	<0.001	6.99	(6.84, 7.12)	<0.001
		Taxi in	4017	6.52	6.00	2.86							
	3	Taxi out	2268	12.93	12.50	3.09	7.32	3.90	(7.16, 7.48)	<0.001	7.25	(7.09, 7.38)	<0.001
		Taxi in	2268	5.61	5.00	2.39							
	5	Taxi out	1186	15.11	14.96	2.99	8.21	3.72	(8.00, 8.43)	<0.001	8.24	(8.05, 8.42)	<0.001
		Taxi in	1186	6.90	6.33	2.62							
L	0	Taxi out	2544	22.29	19.50	8.34	10.40	7.28	(10.11, 10.68)	<0.001	9.56	(9.29, 9.83)	<0.001
		Taxi in	2544	11.89	11.00	4.32							
	1	Taxi out	2546	18.56	16.44	7.23	9.68	7.49	(9.39, 9.97)	<0.001	8.55	(8.34, 8.8)	<0.001
		Taxi in	2546	8.88	8.30	2.70							
	2	Taxi out	2550	17.17	16.36	4.03	7.90	3.88	(7.75, 8.05)	<0.001	7.68	(7.54, 7.82)	<0.001
		Taxi in	2550	9.27	8.75	2.73							
	3	Taxi out	2513	19.68	19.04	5.27	7.88	3.88	(7.65, 8.10)	<0.001	7.47	(7.28, 7.66)	<0.001
		Taxi in	2513	11.81	11.40	3.36							
	4	Taxi out	2559	19.96	18.78	5.49	10.39	6.06	(10.15, 10.62)	<0.001	10.15	(9.96, 10.34)	<0.001
		Taxi in	2559	9.57	8.67	4.17							
	5	Taxi out	1280	17.00	16.63	3.20	6.29	3.96	(6.07, 6.51)	<0.001	6.17	(5.98, 6.36)	<0.001
		Taxi in	1280	10.71	10.25	2.74							

Note. The sample size *n* represents the number of all quarter-hours with at least one departure and one arrival, i.e., zeros have been removed from the taxi-time data.

Discussions

Taxi time has been identified as a significant factor that may affect airport capacity, congestion, fuel burn, and emissions. In this paper, average quarter-hour taxi-time data (30,676 data points) were collected from 33 U.S. airports (11 each from small, medium, and large hubs) and analyzed to compare taxi-out time with taxi-in time for each of the three hub classifications (S/M/L) and each of the six numbers of hot spots (0,1,2,3,4,5). For the research questions in this paper, the researchers used paired *t*-tests to compare the mean taxi-out time with mean taxi-in time. Due to the large number of outliers in the data, the researchers also used the Wilcoxon Signed Rank Test to compare the median taxi-out time with median taxi-in time. The results were consistent between the two tests.

This research uses the following assumptions:

1. The average quarter-hour taxi time data collected from the FAA ASPM represent the real taxi time at the U.S. hub airports.
2. The sample of 33 chosen airports can be representative of U.S. hub airports.
3. The NPIAS hub classification can reflect the number of flights.
4. The number of hot spots can reflect the airport physical configuration complexity.
5. Pairs of average quarter-hour taxi time data with either taxi-out or taxi-in time reported as zero were removed from the data. The taxi time used in the analysis is based on the condition that there was at least one departure and one arrival in that specific quarter-hour.

This research is subjected to the following limitations and delimitations:

1. The taxi time samples in this research are collected from 11 of the busiest U.S. hub airports for each of the three hub classifications (small, medium, and large hubs).
2. The population of this research is the hub airports in the U.S. in the ASPM77.
3. The number of hot spots in U.S. airports ranges from 0 to 9. The number of hotspots for the 33 airports selected in ASPM7 ranges from 0 to 5. There were no small hub airports with three hot spots and no medium hub airports with 4 hot spots in the sampled 33 airports, which could bias the analysis results or reduce the statistical power of this research.
4. The taxi time data collected from the ASPM dataset are average quarter-hour taxi time, not the specific taxi time of each flight. Therefore, the standard deviation of taxi time is expected to be lower if individual taxi time data were available.
5. The data collected resulted in violations of normality and constant variance assumptions for the *t*-tests. The large sample size (n = 30,676) in this study may improve the validity of the *t*-tests in terms of normality assumption with respect to the Central Limit Theorem.
6. This research does not consider the variations in taxi time caused by different airport operational capacities or demands, airport management, equipment, weather, aircraft type, operation type (maintenance or refueling), or airport physical size and configurations.

Researchers must pay attention to the definitions for taxi time, the procedures to measure taxi time across airports, and the exact events used to start and stop the time measurement. According to the FAA ASPM dataset, taxi-in time is the time difference between Wheels On time and Gate In time; and taxi-out time is the time difference between Gate Out time and Wheels Off time (FAA, n.d.-b). International Civil Aviation Organization (ICAO) defines taxi/ground idle time as the time differences between “initial starting of the propulsion engine(s) and the initiation of the take-off roll; and between the time of runway turn-off and final shutdown of all propulsion engine(s)" (ICAO, 2017, p. I-1-2).

Some of the results in this paper do not align with the researchers' intuitions. For example, the mean and median taxi-in and taxi-out time at airports with 0 hot spots are longer than those at airports with 1, 2, 3, and 4 hot spots; the mean and median taxi-in and taxi-out time at airports with four hot spots are longer than those at airports with five hot spots. This could be a result of the methods used to determine the hot spots by the FAA. For example, as one of the biggest and busiest airports in the world, the Dallas Fort Worth International Airport (DFW) has 0 hot spots on the airport diagram. This could be a reason that the taxi time means and medians at an airport with 0 hot spots are longer than airports with 1, 2, 3, and 4 hotspots. During this research, no literature or documentation was found regarding the methodology to determine the hot spots in airports other than the occurrence of incursions or collisions. Therefore, the researchers are not able to assess the feasibility of using the number of hot spots as an indicator of airport configuration complexity and number of intersections.

It is commonly known that taxi-out time is generally longer than taxi-in time due to queueing for take-off and to traffic managers' priority used for takeoffs versus landings. The objective of this research is to explore if taxi out is longer than taxi in when hub classification and the number of hot spots are taken into consideration. The results of this paper show that taxi-out time is longer than taxi-in time regardless of airport hub classification and number of hot spots. The results suggest that despite the number of enplanements and the number of complex intersections, taxi-out time is still longer than taxi-in time at hub airports.

Conclusion

In this research, the taxi-out time were compared to the taxi-in time for each of the three airport hub classifications (Small/Medium/Large) and each of the six numbers of hot spots (0, 1, 2, 3, 4, 5). The researchers collected taxi time data from the FAA ASPM dataset, the hub classification information from the FAA NPIAS report, and the hot spot data from the FAA airport diagrams. The researchers selected 11 airports with the highest numbers of total operations in each hub classification. The taxi time for each of the 20 days with the highest number of daily operations in the timeframe were selected for each of the 33 sampled airports as the sample data. The data collected are in pairs, and the zeros were removed from the data, meaning that for each quarter hour, both a taxi-out and a taxi-in time had to be reported. Consistent with the experience of those familiar with airport operations, the mean and median airport taxi-out time was found to be significantly longer than the mean and median taxi-in time in the combined sample (without considering hub classification or hot spots). When analyzed separately, the mean and median taxi-out time was found to be significantly longer than the mean and median taxi-in time for each of the three airport hub classifications (S/M/L). For each of the six numbers of hot spots (0, 1, 2, 3, 4, 5) at airports, the mean and median taxi-out time was found to be significantly longer than the mean and median taxi-in time. When the samples were divided by both hub classifications and number of hot spots, the results showed that mean and median taxi out time are significantly longer than taxi in time for each combination of hub classification and number of hot spots. By observing individual airport data for the number of hotspots at different hub sizes, the researchers noticed that for some airports in the same category, the number of hotspots might vary widely, e.g., large hub airports such as DFW (0 hotspots) and LAX (5 hotspots).

Future work may reduce the target sample to focus on specific airports with currently constrained capacity or that are predicted to be congested in the future. In this paper, average quarter-hour taxi time were collected from the ASPM dataset. Other taxi time data sources (such as Airport Surface Detection Equipment - Model X) that provide more specific taxi information, including routes, distances, and taxi time of each operation in minutes, may be used to improve the statistical power of the tests. Future research could also consider other factors that might affect taxi time, such as weather conditions or airport configuration, among others, or other methodologies, such as simulation analysis or Bayesian analyses.

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Pilot Study for Cabin Crew’s Willingness to Operate on Single Pilot Operations

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Single-pilot operations are already in place within military aircraft, small modes of commercial passenger transportation, and cargo operations. NASA, aircraft manufacturers, and airlines are collaborating on projects that birth safe and efficient single-pilot operation suitable technology for commercial airliners. A stipulated number of cabin crew is required per number of passengers on commercial airliners for safety, security, and medical purposes. The purpose of this pilot study was to determine what scales are valid to assess factors that affect a cabin crew’s willingness to operate on single pilot operations. With the selection of appropriate scales, such findings could aid industry regulators, government bodies, and airlines with training programs, educational conferences, and procedural development. The pilot study surveyed members of the cabin crew population using voluntary response sampling. The cabin crew was presented with a survey that collected demographic data, affect ratings, technology acceptance model perceptions, personality traits, and willingness to operate scores. The validity of the scales was tested using Cronbach’s Alpha in SPSS, and the usability of the survey instrument was assessed. The affect scale was shown not to be valid. In a follow-up study, the aim will be to use a survey containing the six remaining valid scales and collect demographic data to determine which predictors will be significant in a regression model.

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Introduction

Cabin crews are mandated to communicate any safety, security, or medical abnormalities clearly, concisely, and in a timely manner to the flight crew (IATA, 2020). The flight crew will evaluate the situation, liaise further with the cabin crew, and carry out any action that is deemed necessary. Cabin crew also rely on the flight crew for support, information, or authorization for action regarding concerns or emergencies with the passengers, the aircraft, or other crew members. Crew resource management programs have fostered better teamwork and communication between flight crew and cabin crew (Kanki et al., 2019; Salas et al., 2006). Communication between the two crews has become more respectful, open, and of an informative nature (Federal Aviation Administration [FAA], 2004; Thomas, 1989). Soft skills such as self-awareness, decision-making, leadership, and situational awareness are promoted by stressing the importance and value of all resources towards safe flight. A reduction from two or more flight crew to a single onboard pilot could impact the dynamic between the cabin crew and the flight crew. Pilot unions have voiced their concern over the safety of single-pilot operations (SPOs) (Air Line Pilots Association, 2019). However, limited research has been conducted into the effect SPOs may have on the cabin crew role.

The implementation of a flight deck with single pilot capacity on commercial airliners has recently been further popularized by Airbus (Frost, 2021). Airlines such as Cathay Pacific and Lufthansa have been named as collaborators on the venture entitled ‘Project Connect’, which investigates reduced crew operations on long-haul sectors during high-altitude cruises (Frost, 2021). The promotion of a single pilot system being incorporated into the design phase of the Airbus 350 flight deck has generated the interest of the public, industry, government, and regulatory acceptability (Frost, 2021). The cabin crew's willingness to operate (WTO) on SPOs could be impactful to the operational success of SPOs. The aim of this pilot study was to verify a survey instrument and validate scales that would determine cabin crew WTO on SPOs.

Statement of the Problem

Cabin crew and flight crew communicate on a periodical basis, more so should a safety, security, or medical abnormality or emergency arise (IATA, 2020). Currently, two or more flight crew may be seated on the flight deck of a commercial airliner. The workload of the onboard pilot in SPOs is highlighted as an area of concern in research (NASA, 2005; Schmid & Stanton, 2019, 2020; Schutte, 2015; Stanton et al., 2017; Vu et al., 2018; Wyman, 2017; Young et al., 2015). The level of involvement that the single onboard pilot will be able to maintain with cabin operations and flight planning may be limited (Myers et al., 2021). This could also mean that the level of interaction the single onboard pilot will be able to maintain with the cabin crew may be limited. There is limited research on how the cabin crew role may have to evolve under SPOs. Further, there is limited research on how cabin crew view operating on SPOs and what factors would influence their WTO on SPOs.

The purpose of this paper is to present a pilot study for the proposed research, in which a non-experimental, quantitative study on a non-probability, voluntary response sampling of cabin crew will be conducted. Scales were validated, and the survey instrument was tested so that in a follow-on study, cabin crew WTO on SPOs could be evaluated. A hypothesis was presented in a survey format, and cabin crews were asked about their WTO on SPOs, using the willingness to pilot an aircraft scale created by Rice et al. (2020) and adapted in Vempati et al.'s (2021) Pilots' WTO in Unmanned Aircraft System Integrated Airspace research. Affect ratings were collected on the hypothesis (Ekman & Friesen, 1971). Using a five-point Likert scale, ratings were collected on the complexity of SPOs, familiarity with SPOs, perceived safety of SPOs, and the participant's wariness of new technology, concepts deduced from Davis' (1989) technology acceptance model. Personality traits were collected (Donnellan et al., 2006), as well as demographic data (age, gender, nationality, operational grade, and total time spent as cabin crew). Data was analyzed to determine which scales were valid, as well as assess the usability of the survey instrument.

Significance of the Study

Members of the public and industry affiliates have voiced their discomfort regarding SPOs on commercial airliners (Air Line Pilots Association, 2019). The following arise as concerns: reduced situational awareness, increased workload, ability to handle an emergency solo (single onboard pilot), ability to handle an emergency solo (ground pilot), human factors issues between crew (flight crew, ground crew, cabin crew, airline operations, or air traffic control), medical emergencies on the flight deck, handling of inevitable contingency planning, loss of air-to-ground communications, technology readiness, technology failure, overreliance on automation, cybersecurity, and security risks (Air Line Pilots Association, 2019). Industry regulators and government agencies are in discussions about the necessary policies and procedures that would need to be in place before certification. There is limited knowledge of the cabin crew's perspective regarding SPOs. This pilot study identified the appropriate scales to measure quantitative research that aims to bridge the gap in knowledge regarding cabin crew WTO on SPOs. This pilot study also tested the survey instrument so it can be adapted for use in a larger study. A follow-up study will aim to identify factors that influence cabin crew WTO on SPOs. The findings could aid industry regulators, government bodies, and airlines in administering training programs, hosting educational conferences, and conducting procedural development.

Proposed Research Questions and Hypotheses

The current pilot study used quantitative methods and a non-experimental research design to test a survey instrument that identifies factors that could predict a cabin crew's WTO on SPOs. The survey instrument was designed using potential follow-on study research questions:

RQ_1: What demographic variables (age, biological sex, nationality, education level, operating grade, or the number of years as cabin crew) are significant predictors of a cabin crew's WTO on SPOs?

H_{A1}: At least one demographic variable is a significant predictor of a cabin crew's WTO on SPOs.

RQ_2: Which of Ekman and Friesens' (1971) six (anger, disgust, fear, happiness, sadness, and surprise) universal emotions (affect) are significant predictors of a cabin crew's WTO on SPOs?

H_{A2}: At least one affective emotion (of the six universal emotions) is a significant predictor of a cabin crew's WTO on SPOs.

RQ_3: Which of Donnellan et al.'s (2006) big five personality traits (extraversion, agreeableness, conscientiousness, neuroticism, and intellect/imagination) are significant predictors of a cabin crew's WTO on SPOs?

H_{A3}: At least one of the personality traits is a significant predictor of a cabin crew's WTO on SPOs.

RQ_4: Which of Davis' (1989) technology acceptance model concepts adapted by Rice et al. (2019) into the scales: complexity, familiarity, value, fun, and wariness of new technology are significant predictors of a cabin crew's WTO on SPOs

H_{A4}: At least one technology acceptance model concept is a significant predictor of a cabin crew's WTO on SPOs.

Literature Review

The Cabin Crew's Role

The cabin crew's role is to maintain the safety, security, as well as well-being of the flight crew, other cabin crew, and passengers whilst on the aircraft (International Air Transport Association [IATA], 2020). These responsibilities frequently require the input of other stakeholders, such as ground staff, security personnel, engineers, medical professionals, and the flight crew. Whether in-flight or on-ground, the cabin crew may liaise with such stakeholders through the flight crew. The telecommunications technology used to connect the crew on the aircraft and stakeholders on the ground may only be in the flight deck.

The chain-of-command dictates that the cabin crew inform the flight crew of any observed safety, security, or medical abnormalities (FAA, 2020a; IATA, 2020). With two flight crews on the flight deck, one can take control of the aircraft, and the other can address the cabin crew's concerns. The cabin crew may require direct input from the flight crew regarding a situation, for example, offloading a disruptive passenger or diverting due to a medical case. These types of requests would increase the workload of the flight crew.

Communications between Cabin Crew and Flight Crew

The Chute and Wiener (1994, 1995, 1996) studies highlighted how ineffective communications between cabin crew and flight crew could be detrimental to safe practices. Crew resource management (CRM) has been implemented within the commercial aviation industry, and joint training sessions between the flight crew and cabin crew are encouraged. In CRM, soft skills such as leadership, decision-making, self-awareness, communication, fatigue, and stress are the focus. Individuals are encouraged to nurture a mindset that fosters healthy teamwork and values each resource for the contribution they can make toward a safe flight. Perceptions towards cabin crew contributing information on safety scenarios have changed over the decades (Chute &

Wiener, 1994). However, constant reinforcement of the importance of cabin crew contribution from an authoritative figure for junior, less experienced, or under-confident cabin crew can persuade them that their input is valuable (Bienefeld & Grote, 2012, 2013; Chute & Wiener, 1995, 1996). CRM has cultivated a positive evolution in communication etiquette between the flight crew and cabin crew over the past 30 years (Edwards, 1992; Kanki et al., 2019; Martin, 2017; Salas et al., 2006). Thus, the removal of a flight crew member from the flight deck for SPO could impact cabin crew operations, which may affect the cabin crew's perception of how effectively they could operate with a single pilot.

Commercial Airline Single Pilot Operations

Over the past 80 years, the flight deck has become less crowded. Advancements in technology have resulted in the reduction of navigators, radio operators, relief first officers, and flight engineers (Frow, 2016). Currently, the United States Federal Aviation Administration (FAA) regulations CFR 14 Part 121.385 require that a minimum of two persons are required to fly a large plane safely (FAA, 2020b).

In a step towards further reducing occupancy of the flight deck during long-haul flights whilst at high altitudes, Airbus has partnered with Cathay Pacific and Lufthansa (Frost, 2021). All flight crew must be present during critical phases of the flight. However, during the cruise phase, one single flight crew member remains on the flight deck, and the remaining crew members may rest in the crew bunks (Matessa, 2014); this arrangement is called reduced crew operations (RCOs), and the Airbus/Cathay Pacific/Lufthansa collaboration, entitled “Project Connect”, has the agenda of delivering A350s with in-flight single-pilot capacity by 2025 (Frost, 2021).

In SPOs, only one pilot would be present onboard the aircraft to operate alongside integrated ground support systems (Matessa et al., 2014; Vu et al., 2018). The US House and Senate voted in favor of a bill that would order the FAA to research remote and computer piloting of SPOs for cargo aircraft (FAA Reauthorization Act of 2018, 2018; Reed, 2018). The FAA is coordinating with NASA and other agencies (Comerford et al., 2013), with research broadening to SPO adoption by commercial airliners.

Technological advances and industry investment are not waning, despite critique of the SPO configuration. There is skepticism towards the capability of autonomous or automated flight. The separation and fragmented dynamics between the single onboard pilot and integrated ground support systems cause a lack of situational awareness and a breakdown in crew resource management (Brandt et al., 2015; Lachter et al., 2014; Lachter et al., 2017). Positive public perception of SPOs is driven by familiarity with the technology, level of understanding about the technology, adaptability to technological advances, and age (Rice & Winter, 2015; Rice et al., 2019; Vance & Malik, 2015). There is also the fear that SPOs will catalyze the concept of human being replaced by machines, leading to fully autonomous flight, and cause a loss of high-paying flight crew positions, which, for some, is a benefit. Airlines highlight the potential savings of SPOs, eliminating 50% of the human resources from the flight deck, as well as easing the looming pilot shortage forecast by industry growth projections (Airbus, 2019; Boeing, 2020; IATA, 2007; Murray, 2021; Rice, 2019).

Variables and Scales

Predictive Factors of Interest as Independent Variables

The section below lists studies that evaluate dependent variables of willingness. The studies listed below demonstrate that willingness can depend on factors such as demographics, emotional reaction (affect), experience and exposure, and personality traits. Therefore, this current study explored 23 such predictors that may influence cabin crew WTO on SPOs. They are listed in Table 1.

Table 1
Predictor Variables and How They Are Measured

Independent Variable	Scale	Measurement Type
Age	Free Response	Interval
Gender	Multiple Choice	Categorical
Nationality	Free Response	Categorical
Education	Multiple Choice	Categorical
Years working as Cabin Crew	Multiple Choice	Continuous
Operational Grade	Multiple Choice	Categorical
Years working in Grade	Multiple Choice	Continuous
Anger (Affect Scale)	Likert-type question*	Interval
Disgust (Affect Scale)	Likert-type question*	Interval
Fear (Affect Scale)	Likert-type question*	Interval
Happiness (Affect Scale)	Likert-type question*	Interval
Sadness (Affect Scale)	Likert-type question*	Interval
Surprise (Affect Scale)	Likert-type question*	Interval
Complexity Perception Scale	Likert-type question**	Interval
Familiarity Scale	Likert-type question**	Interval
Value Scale	Likert-type question**	Interval
Fun Factor Scale	Likert-type question**	Interval
Wariness of New Technology Scale	Likert-type question**	Interval
Conscientiousness	Subscale of Mini-IPIP***	Interval
Extraversion	Subscale of Mini-IPIP***	Interval
Agreeableness	Subscale of Mini-IPIP***	Interval
Neuroticism	Subscale of Mini-IPIP***	Interval
Intellect/Imagination	Subscale of Mini-IPIP***	Interval

Note. ** (Ekman & Friesen, 1971), **(Davis, 1989), ***(Donnellan et al., 2006)*

Willingness to Operate as a Dependent Variable

The WTO scale was used in a study by Vempati et al. (2021). The WTO scale is validated and based on the updated willingness to fly (WTF) scale by Winter et al. (2020). WTO assesses a participant's willingness to work with, handle, or control under certain conditions. WTF assesses a participant's willingness to be flown under certain conditions. Rice, Mehta et al., (2015) created the WTF scale to predict consumer attitudes and behaviors. It has been utilized in studies to investigate WTF under different conditions, namely, WTF if pilots are taking depression medications (Rice, Winter, et al., 2015), WTF depending on the gender of the flight crew composition and flying under automation (Mehta et al., 2017), and WTF in autonomous commercial aircraft (Ragbir et al., 2018; Rice et al., 2019). The WTF scale was updated by Rice, Winter et al. (2020) and used to predict WTF during and after the 2019 Coronavirus disease (COVID-19) pandemic (Lamb et al., 2020), WTF in autonomous air taxis (Ward, 2020), WTF based on CEO diversity (Crouse & Lamb, 2021), and WTF domestically or internationally with a COVID-19 health passport (Crouse et al., 2021). The WTF scale has been adapted by researchers to fit their purpose, for example in willingness to ride (Anania et al., 2018), willingness to travel (Winter & Trombley., 2019), willingness to live (Winter & Trombley., 2019), willingness to undergo surgery (2019), willingness to pilot (Rice, Winter, et al., 2020), and willingness to operate (Vempati et al., 2021). The WTO scale has demonstrated validity and reliability and was used as a dependent variable in this current study.

Methodology

The following section describes the methodology for a non-experimental, quantitative study on a non-probability, voluntary response sampling of cabin crew.

Pilot Study

To verify the validity and reliability of the data collection device and scales, the researcher did a pilot study (Ruel et al., 2016). The pilot study also served to test the survey distribution platform, sampling choice, response rate, and data collection rate (Ruel et al., 2016). IRB approval was obtained. Moore et al. (2011) state that some researchers opt not to justify the sample size in a pilot study. In other research, a minimum of 60 – 100 participants, or 10% of the anticipated research sample size, is recommended (Gorsuch,1983; Hertzog, 2008; Kline,1994; MacCallum et al., 2001). Julious (2005) and van Belle (2002) presented evidence that a sample size of 12 participants per group improved the confidence levels of pilot studies, whereas increasing beyond 12 did not. Isaac and Michael (1995) recommend 10-30 participants for pilot studies using a survey approach. The current pilot study had a target sample size of 30.

Sampling

The current study was open to all cabin crew on a selected social network platform (SNS). It did not target one airline or one cabin crew organization. Non-probability sampling was used due to the lack of an international cabin crew database (Spence et al., 2016). A hybrid of voluntary response sampling, combined with a version of network-driven sampling (purposive sampling, respondent-driven sampling, and snowball sampling) was used to capture the maximum number of relevant participants using SNS (Babbie, 2013; Sibona & Walczak, 2012; Vogt et al., 2012).

SNS research

Due to the limited time frame of the current pilot study and the broad distribution of the target audience, an SNS was used to disseminate the data collection device. "Access to participants via SNSs is an increasing form of locating research participants versus traditional data gathering methods…with positive results" (Petitt, 2019, p. 82). Facebook groups are created around topics of interest. The cabin crew-centric Facebook groups targeted in this current study had a verification process prior to acceptance, which increased the probability that only verified cabin crew would view the initial 'call for participants' post.

Distribution Platform

A recruitment post was placed on cabin crew-related Facebook groups advertising the need for participants to complete a 15-minute survey. Willing participants were invited to click on a link and were redirected to a survey in Google Forms. The initial page was an informed consent form. Participants were then invited to commence answering survey questions. First, there were demographic inquiries and questions related to the length of employment. Second was Rice et al.'s (2020) WTO scale. Third was Donnellan et al.'s **(2006)** personality scale. Fourth was Ekman & Friesen's (1971) affect scale after reading a hypothetical scenario. Last, there were scales rating complexity, familiarity, value, fun, and wariness of new technology created by Rice et al. (2019) based on Davis' (1989) technology acceptance model. A detailed description of each survey instrument section is provided in Appendices A, B, C, D, and E.

Data Analysis Approach

An efficiency evaluation of the survey instrument was conducted. The data was downloaded from Google Forms, prepared in Excel, and imported into SPSS. The Cronbach's Alpha was calculated to assess the scales' validity. A Cronbach's Alpha of 0.7 or more represents acceptable internal consistency (Taber, 2018; Truong, 2016; Wilson & Joye, 2016).

Results

Thirty-six responses from three cabin crew-centric Facebook groups were collected over a period of seven days. A higher frequency response rate was expected. Other avenues of survey distribution will have to be considered for a follow-on study. The final sample size used for the pilot study was 30 (Female = 20, Male = 10). The surveys removed were either incomplete, had single-answer questions with multiple responses, or were from participants with three or more sections of unengaged, straight-lined responses. The mean age was 37.13 (SD = 6.46) years. A broad range of education levels, grades, years of cabin crew experience, and experience in grades were collected; the Facebook platform was effective for sampling cabin crew diversity. These are presented in Table 2, Table 3, and Table 4, respectively. The diverse range of nationalities may pose a challenge for data analysis. A nationality overview is presented in Table 5.

Table 2
Years of Experience as Cabin Crew and Years of Experience in Grade

	Tenure as Cabin Crew		Tenure in Grade	
	Total	Percentage	Total	Percentage
Less than 1 year	0	0%	2	6.7%
1 – 2 years	1	3.3%	5	16.7%
3 – 4 years	2	6.7%	3	10%
5 – 9 years	6	20%	13	43.3%
10 – 14 years	12	40%	6	20.0%
15 – 19 years	7	23.3%	1	3.3%
20 + years	2	6.7%	0	0
Total	30	100%	30	100%

Cronbach's Alpha was calculated on seven scales, Ekman & Friesen's (1971) affect scale, Rice et al.'s (2019) complexity, familiarity, value, fun, and wariness of new technology scales based on Davis' (1989) technology acceptance model, and Rice et al.'s (2020) WTO scale. The affect scale was shown to not be valid with a Cronbach's Alpha of < 0.7, which does not indicate good reliability (Taber, 2018; Truong, 2016; Wilson & Joye, 2016). The six other scales were shown to be valid. A summary of Cronbach's Alpha is presented in Table 6.

Table 3
Participant Education Levels

Education Level	Total	Percentage
High school Degree or Equivalent	3	10%
Sixth Form College or College Diploma Equivalent	1	3.3&
Bachelors Degree	17	56.7%
Master Degree	9	30%
PhD	0	0
Total	30	100%

Table 4
Participant Operational Cabin Crew Grade

Grade	Total	Percentage
Economy	4	13.3%
Business	2	6.7%
First	6	20%
Cabin Supervisor	6	20%
Purser	12	40%
Total	30	100%

Table 5
Participant Nationalities

Nationality	Total	Percentage
Australian	3	10%
British	2	6.7%
Bulgarian	2	6.7%
Chinese	1	3.3%
Egyptian	1	3.3%
Filipino	3	6.7%
German	1	3.3%
Greek	2	6.7%
Indonesian	1	3.3%
Jordanian	1	3.3%
Kazakh	1	3.3%
Lebanese	1	3.3%
Mauritian	1	3.3%
Moldovan	1	3.3%
New Zealand	1	3.3%
Panamanian	1	3.3%
Russian	2	6.7%
Spanish	1	3.3%
Tunisian	2	6.7%
Turkish	1	3.3%
Total	30	100%

Table 6
Cronbach's Alpha

Scale	Affect	Technology Acceptance Model Complexity	Technology Acceptance Model Familiarity	Technology Acceptance Model Value	Technology Acceptance Model Fun	Technology Acceptance Model Wariness of New Technology	WTO Scale
Cronbach's Alpha	0.480	0.792	0.897	0.875	0.919	0.818	0.963

Discussions and Recommendations

The purpose of this current pilot study was to assess the usability of the survey instrument and determine which scales were valid to assess factors that affect a cabin crew's WTO on SPO. The main study is feasible, with select changes to the protocol.

Implications

Research Instrument

The validity and reliability of the survey instrument could be increased by implementing the following edits. The "required feature", a feature that forces question completion, should only be enabled for the informed consent. In compliance with IRB standards, participants should be permitted not to answer any other section of the survey. As only one answer option is desired for demographic questions, the multiple-choice feature should be enabled and not the check box feature. Questions related to IVs should be placed first in the survey, and questions related to DVs should be placed afterward, which would minimize the chance of hypothesis guessing (Rea, 2014). The question order within each section should be shuffled so they do not appear in the same order for each participant; this would limit the influence of order effects (Rea, 2014). Where possible, the options in the questions should be shuffled so that they do not appear in the same order for each participant; this would limit the influence of order effects (Rea, 2014). Several questions in the personality scale should be reversed to reduce respondent fatigue or the potential for straight-lining (Rea, 2014) and the accuracy of data analysis (Truong, 2016).

Data Analysis

The affect scale Cronbach's Alpha is 0.480, which indicates a lack of validity of the scale (Truong, 2016). When reviewing the affect scale Item-Total Statistics, if Happiness is removed from the affect scale, then the Cronbach's Alpha increases to 0.839. However, removing Happiness may affect the factor structure and result in the omission of information (Truong, 2016). The effect scale and related research questions will be removed from the follow-on study.

For the Technology Acceptance Model Fun scale and WTO scale, a Cronbach's Alpha 0.9 < was obtained. Due to the tendency for redundancy with a Cronbach's Alpha of 0.9 < (Taber, 2018), these scales were simultaneously scrutinized for paraphrasing. Redundancy was not found to be present, so these scales will remain in the follow-up study. The six other scales were shown to be valid and will remain as such in the follow-on study.

Limitations and Delimitations

Accessibility

The survey instrument was created using Google Forms in English. Several potential participants anonymously provided feedback that the survey appeared in Arabic. Google Forms was found to automatically translate the surveys, which potentially hindered the researcher's ability to obtain a sufficient number of responses. The follow-on study will have a survey instrument created on a platform that does not automatically translate surveys.

Response Rate

The response rate was found to be lower than expected, with an average of fewer than 6 surveys completed per day. The invitation to complete the survey was placed on three cabin crew-centric Facebook groups with a combined total of approximately 37,680 members. The proposed 15-minute completion time could have been a deterrent, or the sampling population size too small. An incentive could attract more participants.

Recommendations

Streamlining the Data

The 20 nationalities presented by participants may pose a challenge for statistical analysis. Differentiating races as per continent or presenting common ethnicities were considered as options. However, due to the differing nationality, identity, and culture base, the allocation of ethnicity or race may not be indicative of any preference. Instead, allocating the individualistic or collective nature to a nationality could minimize variables and indicate the likelihood of technology acceptance (Huang et al., 2019; Lee et al., 2013), which would be done using the Geert Hofstede cultural dimension individualism tool.

Some predictors had more than two possible answer selections. It was noted that compression of variables may be possible and advantageous. Where there was a lack of contributing data, the number of choices could be reduced, which would also ease data analysis. Education level had the selections of a high school degree or equivalent, 6th form college or a college diploma equivalent, bachelor’s degree, master’s degree, or doctoral degree. The data showed that 30% had a master’s degree, 56.67% had a bachelor’s degree, and 13.33% had a college or high school diploma. Thus, education level could be reduced to two choices: a bachelor’s degree or lower and a master’s or higher. Age was a free-response question. To ease analysis, age could be compartmentalized into multiple-choice, and then, if applicable, the selections could be further reduced.

Follow-up Study

The follow-on study will use the statistical analysis of backward stepwise regression. An assumption for backward stepwise regression is that with 17 variables, approximately (170 x 2) 340 participants are required, as per G*Power (Heinrich-Heine-Universität Düsseldorf., n.d.). Additional participants may be required to account for the margin of error. Thus, approximately 500 participants will be targeted in the follow-up study.

The factors that will influence a cabin crew's WTO on SPOs have not yet been studied. A quantitative research method with a non-experimental, correlational design will be used; this will provide statistical analysis for the follow-on exploratory study to investigate the research questions (Creswell & Creswell, 2018; Edmonds & Kennedy, 2016). Due to the exploratory nature of the research, backward stepwise regression is preferred. A saturated model including all 17 predictors will initially be present; then, variables will be eliminated one by one from the regression model to create a final model that best explains the data (Thayer, 2002). The best approach to gather the data required for a follow-up study will be a survey instrument.

The proposed follow-on study may impact aviation in the future, as the cabin crew's WTO on SPO contributes to its operational success. Furthermore, identifying areas of concern would allow operators and regulators to design supportive procedures and training for cabin crew operating on commercial aircraft with SPO. These actions may optimize the successful execution of the evolving cabin crew role on SPO and better support ground operations and the single onboard pilot in their respective roles.

Conclusion

The pilot study achieved its purpose of identifying the usability of the survey instrument. Areas for improvement have been identified, and the survey instrument has been refined. A revised survey instrument will be used to collect data. The scales have been assessed, and changes will be implemented to improve the validity of the execution of a full-scale survey. The completed pilot study demonstrated the validity of six scales to investigate a cabin crew's WTO on SPO. These results will inform the methodology of a follow-up study with a larger sample size. To ensure that the appropriate assumptions are met, a statistical analysis will be conducted to evaluate which predictors influence a cabin crew's WTO on SPO.

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An Evaluation of the "Police Response to Uncrewed Aircraft Systems Operations" Online Training Program

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This study evaluates the impact of the "Police Response to Uncrewed Aircraft Systems Operations" online training program of officers from the Daytona Beach Police Department (DBPD). By measuring the effectiveness of the training through pretest and posttest assessments and considering variables such as educational background, length of service, and rank, this research underscores the training's potential to enhance UAS response capabilities. Employing a self-selection sampling method, the study engaged 82 voluntary participants from the DBPD, revealing significant improvement across all groups in UAS knowledge and confidence levels. Despite limitations, these findings offer compelling evidence of the training's efficacy and advocate for continuous education to strengthen law enforcement's readiness and public safety preparedness in the face of evolving technological challenges. Future investigations should delve into long-term effects and underlying factors to bolster the robustness of these results.

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Introduction

Daily uncrewed aircraft systems (UAS) flights in the United States are expected to reach 1 million by 2035 (NBC, 2015). UAS is an emerging technology with low entry barriers for individuals who want to fly UAS in the National Airspace System (NAS). Anyone can purchase a UAS online or in person in a store without any required documentation from the Federal Aviation Administration (FAA) or the US Government. To fly a UAS in the NAS, individuals must follow specific federal and state regulations based on the purpose of the flight and the airspace in which the flight will be conducted to ensure safe operations (FAA, 2023b). UAS can be remotely piloted by an individual or autonomously programmed using computer software to follow global positioning system (GPS) coordinates. UAS comes in a variety of sizes and designs and can be modified to do specified tasks for dull, dirty, and dangerous jobs (Cerreta et al., 2022).

The growing prevalence of affordable small drones presents numerous challenges in effectively integrating Unmanned Aircraft Systems (UAS) operations into the national airspace system (Potana et al., 2023). So far, the FAA has released only limited information online regarding 15,644 "UAS Sighting Reports" from the United States, covering the period between 2014 and the conclusion of 2022 (Howard, 2023). The FAA continues to receive upwards of 100 such reports. There is a significant chance of UAS activity in the coming years, potentially leading to more safety incidents (Howard, 2023). Using airspace by unmanned aerial vehicles necessitates adjusting to a mounting array of legal regulations (Kubas, 2023). Operating Uncrewed Aircraft Systems (UAS) in proximity to airports and aircraft is not inherently unsafe or illegal. The FAA emphasizes that operating Unmanned Aircraft Systems (UAS) near aircraft, helicopters, and airports can potentially pose significant security and safety risks, among other issues if regulations are not adhered to diligently. There is a propensity for a collision between a crewed aircraft and a UAS near airports since they both fly at low altitudes, even though UAS are prohibited from flying in these critical areas (Pothana et al., 2023).
On July 21, 2022, according to the FAA, officials stopped incoming and outgoing flights at Ronald Reagan Washington National Airport for approximately 13 minutes after a UAS sighting was reported (Shepardson, 2022). The FAA reported that it quickly alerted law enforcement, and those operations had resumed, albeit with lingering delays. The perpetrator has not yet been located. The region surrounding Ronald Reagan Washington National Airport has the most stringent UAS restrictions in the United States (FAA, n.d.). Without specific FAA permission, flying a UAS within a 15-mile radius of the airport is illegal, a condition that applies to all of Washington, DC. Even with the limits, infractions go unpunished, perpetuating the critical issue (FAA, n.d.). The FAA relies on a voluntary compliance methodology for all UAS operators and those reporting the sightings (FAA, 2023b). Unauthorized operators may face severe financial penalties and criminal prosecution, including possible imprisonment (FAA, 2022a).

Police officers are required to handle calls for service ranging from delivering babies and bringing life into the world to taking a human life when an imminent deadly threat exists and presents itself. Within this vast range of incidents, police officers are expected to handle service calls involving citizens operating uncrewed aircraft systems (UAS) legally and illegally. Modern policing requires police officers to respond to various incidents, including authorized, criminal, and nefarious UAS operations.

State and local Law Enforcement Agencies (LEAs) are frequently the most effective entities to deter, detect, promptly investigate, and, when necessary, take enforcement actions to halt unauthorized Unmanned Aircraft Systems (UAS) operations (Justice Technology Information Center, 2016). Unfortunately, in contemporary policing, there is no mandatory training for police officers on responding to and investigating UAS incidents, which could endanger public safety (Agata & Galante, 2017). As technology evolves, police agencies must better serve and protect their citizens. This study measured the change in scores between pretest and posttest assessments, considering officers' highest educational degree (high school diploma, associate degree, bachelor's degree, or master's degree), length of service in the department, and rank. The researchers examined the online training module's impact to see if police officers' performance improved statistically.

Purpose

The study evaluates the effectiveness of the online training module, "Police Response to Uncrewed Aircraft Systems Operations," provided to a sample of Daytona Beach Police Department (DBPD) officers.

Importance of the Study

A thorough UAS response and investigation training regimen needs to be tailored for police officers. Such a program is essential for equipping them with the requisite knowledge, skills, and abilities to proficiently execute their duties in the field, ensuring effective service to their communities (Agata & Galante, 2017). Past incidents have highlighted instances where police officers halted UAS operators, inadvertently infringing their rights (FAA, 2022e). To prevent such occurrences in the future, police officers must undergo adequate training. This study represents a pioneering effort, as it addresses the deficiency of a comprehensive, standardized UAS response and investigation training program for law enforcement personnel.

Research Questions

"Does Police Response to Uncrewed Aircraft Systems Operations training received by police officers with different educational backgrounds and work experience increase their knowledge and confidence regarding their response to UAS operations incidents?" set the foundation for the study. A set of research questions was devised to explore specific facets of the study in greater detail, leading to the formulation of 10 hypotheses.

Uncrewed Aircraft Systems (UAS) in the National Airspace System (NAS)

The proliferation of UAS operations throughout the US can be divided into recreational, commercial, and public aircraft operations. Integrating UAS into the already crowded NAS of the US has presented several challenges and opportunities for the FAA and local police departments, which enforce UAS rules and regulations that have been implemented for the safety of those on the ground and in the air. The FAA Air Traffic Organization (ATO) provides daily service to more than 45,000 flights. It facilitates the transit of approximately 2.9 million airline passengers daily across an expansive airspace that exceeds 29 million square miles (FAA, 2023e). Howard (2023) presents a preliminary analysis of 1,317 Unmanned Aircraft Systems (UAS) sighting reports from the US Federal Aviation Administration (FAA), gathered between July 1, 2020. Most crashes occur in war zones under harsh conditions, which is unlikely to happen in the USA.

The growth of UAS for recreational and commercial purposes is on a continuing upward trend. As UAS operations expand within the NAS, the likelihood of near-midair collisions (NMACs) between UAS and crewed aircraft increases (Wallace et al., 2023). Presently, the primary method of detecting UAS NMACs relies on visual detection by pilots, who then take evasive action. Pilots may report these encounters to the FAA through UAS sighting reports. The FAA uses numerous metrics to assess the potential hazards associated with UAS. Among the valuable data sources are UAS sighting reports submitted by crewed pilots and other pertinent stakeholders who have observed potentially unsafe UAS activities near airplanes, helicopters, and airports. Since the FAA began monitoring UAS sighting incidents in late 2014, there has been a considerable increase in reported sightings. In 2021 alone, the FAA received 2,595 sighting reports, representing more than double the 1,210 reports received during the initial full calendar year of tracking in 2015 (FAA, 2023b).

Due to the predicted increase in UAS operations, the FAA is attentively engaged in addressing various concerns to guarantee the secure integration of UAS within the nation's airspace (US et al. Office [USGAO], 2023). Recent progress has observed the FAA successfully concluding a pilot initiative of this system, enabling the agency to assess various technologies and formulate an implementation plan. However, while significant strides have been made, a lack of execution to provide the proper integration solutions to integrate UAS into the NAS has thrust the problem onto local police departments and their officers. The FAA has failed to develop and distribute standardized training on addressing UAS pilots flying UAS legally and illegally (FAA, 2020). This FAA failure has ultimately placed the burden on local police departments, who are responsible for responding to UAS operations calls, to provide their officers with vetted training to ensure the safety of those in the sky and on the ground, along with protecting the rights of all UAS operators who are stopped by police for investigations (Agata & Galante, 2017). As the FAA perseveres in its steadfast pursuit of the secure and seamless integration of UAS into the NAS, the journey ahead necessitates the resolution of intricate legal, technical, and policy difficulties. Regarding UAS jurisdiction and privacy matters, the legal landscape constantly evolves due to ongoing federal endeavors to establish pivotal safety and security frameworks. Additionally, the scarcity of judicial precedents concerning the compatibility of these requirements with statutory authorities further contributes to the uncertainty of the legal domain (USGAO, 2023). The need to regulate the national airspace system (NAS) for UAS has posed challenges for policymakers and businesses in the US.

Challenges and Risks Associated with UAS Operations

The FAA is committed to creating and maintaining the US's preeminent, secure, and efficient NAS. The FAA carefully upholds the required infrastructure, personnel, and operational procedures to support the world's safest and busiest aviation system (FAA, 2023e). Unfortunately, the FAA is understaffed and does not have adequate personnel to dedicate themselves to the critical issue of UAS integration into the NAS safely and efficiently. President Biden's fiscal 2024 budget proposes a 17% funding increase to enhance FAA facilities and systems (Katz, 2023). However, addressing the crisis at the FAA will not be immediate, as it takes one to three years to train and certify new employees, with approximately 40% of hires dropping out during the training process (Katz, 2023).

Human error is a significant risk factor in UAS operations, encompassing inadequate operator response, mission planning errors, and improper maintenance of the UAS itself. A study conducted by the Air Force Research Laboratory on UAS Predator mishaps indicated that once system failures occurring in the initial years of operation are addressed and mitigated, various human errors occur as the leading risk factor (Herz, 2008). To mitigate these risks, it is critical to prioritize training new and current UAS operators, focusing on developing their operational skills and knowledge base about the UAS and the environment they are operating in to minimize the incidence of human errors.

Finn and Wright (2012) emphasize the importance of addressing privacy and security concerns associated with unmanned aircraft systems (UAS). They highlight the potential infringement of privacy rights due to UAS's capability to capture images and collect data. Precise data collection, retention, consent, and notice guidelines are necessary to ensure responsible and ethical use. Moreover, UAS's vulnerability to cybersecurity threats necessitates robust security measures like encryption, secure data storage, and communication channels. Collaboration between regulatory bodies, operators, and privacy advocates is crucial to developing comprehensive regulations balancing technology benefits with privacy protection. Implementing privacy-enhancing technologies, cybersecurity measures, and public awareness can mitigate risks and promote responsible UAS use, requiring coordinated efforts from multiple government agencies.

Ensuring the reliability and maintenance of unmanned aircraft systems (UAS) is critical for safe and efficient operations, as highlighted by Mrusek et al. (2018). Regular maintenance and inspections are vital for identifying and addressing potential issues or malfunctions. Proper maintenance includes routine checks, repairs, and component replacements to prevent unexpected failures during flight. Adhering to original equipment manufacturers' (OEM) guidelines and timely inspections enhance overall reliability and reduce the risk of operational disruptions or accidents. Organizations should establish robust maintenance programs with trained personnel, prioritize schedule adherence, and promptly address any identified issues to minimize risks. UAS operators can enhance safety and effectiveness across various applications by maintaining high-reliability standards and performing diligent maintenance.

Mid-air collisions between unmanned and crewed aircraft are a significant concern in integrating UAS operations into the National Airspace System (NAS). Current methods rely on visual detection by crewed aircraft pilots, but research on its effectiveness needs to be more conclusive. Standardization and further investigation are needed to ensure safe separation. The FAA mandated Automatic Dependent Surveillance-Broadcast (ADS-B, 2023) capabilities by 2020 to enhance air traffic management, providing crewed pilots with GPS-based aircraft positioning and other data. However, UAS are prohibited from using ADS-B, creating safety concerns by hindering mutual visibility between crewed and uncrewed aircraft. The lack of alignment between remote identification (RID) regulations for unmanned aerial systems (UAS) and the utilization of ADS-B presents significant challenges to airspace safety. UAS operators are mandated to adhere to RID regulations, necessitating the transmission of essential flight information to other UAS operators (Tedeschi et al., 2024)

Existing UAS Training Gaps and Lack of Standardization

The FAA emphasizes collaborating with law enforcement agencies to investigate risky UAS operations to maintain aviation safety (USGAO, 2019). However, FAA inspectors need help obtaining crucial data for thorough investigations, which hinders their effectiveness (Latorella & Prabhu, 2000). Law enforcement's role is pivotal, with police reports being valuable sources of information, but there needs to be more clear guidance and training for officers. Bridging this gap requires comprehensive training and protocols to enable law enforcement to effectively respond to UAS incidents and share pertinent information with the FAA. Despite efforts, communication between the FAA and law enforcement could be more consistent, necessitating a standardized approach to ensure all agencies are adequately informed and prepared to assist in addressing unsafe UAS operations nationwide (FAA, 2022b).

Policing in the Modern Era and the Need for UAS Response Training

Morin et al. (2017) highlight the disparities between law enforcement and the public regarding policing perspectives and policy matters. While police officers advocate for increased presence for effective community patrolling, the public often disagrees. Officers face challenges like disruptive behavior and insufficient resources but express dedication to their departments. Regarding UAS incidents, law enforcement must establish robust policies and response protocols to manage emerging challenges and ensure public safety. It is crucial to differentiate between lawful and unlawful UAS operations and train officers accordingly to interact safely with UAS operators for the well-being of all (Agata & Galante, 2017).

The rise of UAS technology brings new risks, including potential criminal and terrorist exploitation, necessitating measures to safeguard public safety (US Department of Justice [USDOJ], 2023). Concerns include prohibited surveillance, chemical attacks, and kinetic assaults on gatherings or government facilities. Police departments must be equipped to counter these threats for national security.

In contemporary policing, officers enforce laws, ensure justice, and protect individuals. However, there are instances of officers engaging in misconduct, such as evidence suppression or excessive force, which can harm individuals and violate their rights. Police officers can be held liable for such actions if they violate constitutional rights while acting officially. Common claims against officers include unlawful searches, illegal arrests, and the use of excessive or deadly force. Proper training is essential to mitigate such risks. Police departments also hold themselves accountable for officers' conduct and can face legal proceedings for negligence, where failure to exercise reasonable care harms others (Novak et al., 2003). Accountability is crucial for maintaining trust and integrity within law enforcement.

Comprehensive police training is essential for reducing liability and ensuring the safety of both officers and the community. Adequate training enables officers to apply the law accurately, handle complex situations effectively, and foster a culture of accountability within police departments. Legal precedents, like the City of Canton v. Harris case, underscore the duty of municipalities to provide thorough training to their officers (City of Canton, Ohio v. Harris, 1989). Training should address evolving policing demands, cultural competency, and the proper use of advanced technologies (Agata & Galante, 2017). Moreover, clear and regularly updated policies are crucial to guide officers' conduct and procedures, aligning with societal needs and legal standards. Training programs should effectively communicate and educate officers on these policies to ensure their understanding and application in real-world scenarios.

The FAA guides law enforcement agencies (LEAs) in addressing unauthorized and unsafe UAS operations through a comprehensive document. It outlines legal foundations and offers practical advice for collaboration between LEAs and the FAA (FAA, 2022c). However, the FAA's approach to ensuring compliance through "voluntary compliance" lacks effectiveness due to insufficient educational efforts and the burden placed on UAS operators. Local police officers often respond to UAS incidents without proper training, despite their enforcement role alongside the FAA. While the FAA has enforcement measures, its capacity is limited, necessitating collaboration with local police. State and local police have varying capabilities and jurisdictional limitations but are crucial in deterring unauthorized UAS operations. Optimizing enforcement requires strong cooperation between the FAA and local police, leveraging their strengths and resources.

Methodology

This study utilized a self-selection sampling method, allowing officers the freedom to opt into participation. This approach fostered heightened engagement and ensured the inclusion of diverse perspectives. Ethical considerations were meticulously observed throughout the research process. This involved safeguarding participant data confidentiality, prioritizing the welfare of voluntary participants, and adhering to principles of equitable treatment.

Participants completed demographic questionnaires, self-efficacy surveys, pretests, an online training module, and posttests to facilitate comprehensive data collection. Authorization from the DBPD Chief of Police was obtained to disseminate the research training program through official channels, inviting officers to participate voluntarily in a courteous manner.

To ensure data security and confidentiality, Google Forms and Wix software were employed to house data collection documents and training materials on a secure Google Drive account accessible only to the researcher. Before commencing the online training modules, participants underwent a 20-question multiple-choice assessment related to UAS incident response and investigations to gauge their initial understanding of the subject matter.

The online training modules were created by Anthony Galante and covered various topics, including understanding the threat, defining uncrewed aircraft systems, regulation and airspace domain, identifying legal and illegal UAS operations, initial officer response to UAS operations, response continuum, and required response documentation process and completion.

This self-paced training took approximately 60 minutes to complete. Although Galante is esteemed in his field, he prioritized transparency by disclosing his background and affiliations. The training content underwent rigorous peer review to incorporate diverse perspectives. Suggestions for replication in future research were made to identify and mitigate potential biases.

Participants were requested to complete a demographic and self-efficacy questionnaire upon volunteering for the study. These surveys delved into participants' perspectives and experiences with UAS while on duty as police officers. After completing the surveys, participants underwent a 20-question multiple-choice pretest, online training modules, a 20-question posttest, and a post-training self-efficacy questionnaire. This comprehensive process took approximately 60 minutes to finish. All active police officers from the DBPD were eligible to participate, ensuring demographic diversity within the participant pool and enhancing the study's generalizability. Ten hypotheses were tested using the paired samples t-test, which compared the means of two measurements taken from the same participant. The disparity between pretest and posttest scores was calculated, considering various demographic variables collected for each participating police officer. To ensure trustworthiness in the study, the link for the online training was only issued to the official police department email addresses of all sworn DBPD police officers, as this was the study's target group. Before conducting further analysis, the normality of the data for data was assessed using the Shapiro-Wilk test in SPSS, and the data was approximately normally distributed.

Participants

The research study drew its population from the Daytona Beach Police Department (DBPD), which comprises 243 sworn officers, according to Daytona et al. Department (2023). The estimated sample size for this study was approximately 82 officers, constituting roughly one-third of the total number of sworn officers in the DBPD. Given the demanding responsibilities of DBPD's patrol officers in responding to various community calls for service, the sample was obtained through a non-probability self-selection method. Only active DBPD police officers were used in this research study because the training prepared and delivered via the online training modules was specifically designed for active police officers who currently respond to calls for service involving legal and illegal UAS operations.

Results

Respondent Demographics

The sample consisted of 82 certified police officers from DBPD who volunteered to participate in the applied doctoral project. Of the 82 participants, 70 (85.4%) were male, 11 (13.4%) were female, and one (1.2%) preferred not to answer. The minimum age of the participants was 19 years, and the maximum age was 59, for a range of 40 years. The mean age of the participants was 35.71 years. Participants in the study were officers, sergeants, and other ranks. As for the ranks of participants, 66 (80.5%) were officers, 10 (12.2%) were sergeants, and 6 (7.3%) were other ranks. As for the years of service participants, 57 (69.5%) participants had

0-5 years of service, 10 (12.2%) participants had 6-10 years of service, and 15 (18.3%) participants had ten or more years of service. This study included participants with varying levels of completed education with the following breakdown: 36 (43.9%) participants completed high school, 10 (12.2%) participants earned an associate degree, 22 (26.8%) participants earned a bachelor's degree, and 14 (17.1%) participants earned a master's degree. It was found that 6 out of 9 respondents (equivalent to 6.7%) had undergone advanced police training related to Unmanned Aerial Systems (UAS) at the DBPD. In contrast, the majority, comprising 76 respondents (85.4%), had not received any such training. Regarding a policy guiding responses to UAS/drone incidents within DBPD, 55 respondents (61.8%) acknowledged the presence of such a policy. In comparison, 27 respondents (30.3%) expressed skepticism. Furthermore, a significant proportion of respondents, 80 individuals (89.9%), possessed a Federal Aviation Administration (FAA) crewed pilot certificate, underscoring their credentials in manned aviation. Conversely, only two respondents (2.2%) lacked such certification. Regarding call volume experienced by respondents during their tenure at DBPD, a substantial majority, 82 respondents (92.1%), reported handling between 0 and 5 calls. Conversely, a minority of 7 respondents (7.9%) indicated dealing with 21 or more calls, highlighting potential variations in workload distribution among personnel.

Instrument Validity and Reliability Analysis

Factor analysis was performed on the measurement data. Principal Component Analysis served as the extraction method, and the VARIMAX rotation method was utilized to enhance interpretability. A single component was extracted. The item correlation coefficients revealed satisfactory factor loadings exceeding the threshold (>0.5) (Chetty, 2015).

Cronbach's Coefficient Alpha, a frequently employed technique in social science research, was used to assess the construct's internal consistency and reliability. This assessment. Typically, an alpha value exceeding 0.7 is deemed satisfactory, although, for exploratory investigations, this threshold may be as low as 0.60 (Nunnally, 1978; Hair et al., 1998). In this study, the alpha value obtained was 0.951. This research seeks to test the following hypothesis：

Hypothesis 1

H1: Posttest knowledge test scores from the UAS response and investigation training delivered to a sample of DBPD police officers will be higher than pretest knowledge test scores.

A paired samples *t*-test was conducted to compare the mean UAS knowledge scores before and after the UAS response and investigation training. The two-tailed *t*-test revealed a statistically significant difference between the mean UAS knowledge scores before and after the UAS response and investigation training t (15.057) = 2.276. The mean UAS knowledge score before the UAS response and investigation training was 54.63 (SD = 20.288), whereas the mean UAS knowledge score after the UAS response and investigation training was 88.90 (SD = 5.388). These results indicate that the mean scores significantly increased before and after the UAS response and investigation training. These observed findings provide support for H1.

Hypothesis 2

H2: Post-training self-efficacy confidence scores from the UAS response and investigation training delivered to a sample of DBPD police officers will be higher than pretraining self-efficacy confidence scores.

A paired samples t-test was conducted on self-efficacy confidence scores before and after UAS response training, revealing a significant difference ($t(25.761) = 2.106$). From a sample of 82 DBPD officers, the mean pre-and post-test scores were estimated at 54.25 (95% CI [50, 58]). Pre-training confidence scores averaged 9.394 ($SD = 14.186$), while post-training scores averaged 63.644 ($SD = 16.064$). This indicates a significant increase in self-efficacy confidence after the UAS training, supporting H2.

Hypothesis 3

H3: Posttest-training scores from the UAS response and investigation training delivered to a sample of DBPD officers with a high school diploma as their highest level of education will be higher than pretest-training scores.

A paired samples t-test was conducted to assess the UAS knowledge scores of officers with a high school diploma before and after UAS response and investigation training, revealing a significant difference ($t(10.286) = 3.389$). From a sample of 36 DBPD officers, the estimated mean pre-and post-test scores were 34.861 (95% CI [28, 42]), with a margin of error of ±2 points. Before training, the mean UAS knowledge score was 55.14 ($SD = 19.946$), increasing to 90.00 ($SD = 3.780$) after training, as depicted in Table 9. These results demonstrate a significant improvement in scores post-training, supporting H3 and indicating a notable enhancement in UAS knowledge levels among officers with a high school diploma.

Hypothesis 4

H4: Posttest-training scores from the UAS response and investigation training delivered to a sample of DBPD officers with an associate degree, as their highest level of education will be higher than pretest-training scores.

A paired samples t-test was conducted to assess the UAS knowledge scores of officers with an associate degree before and after UAS response and investigation training, showing a significant difference ($t(4.807) = 6.344$). From a sample of 10 DBPD officers, the estimated mean pre-and post-test scores were 30.5 (95% CI [16, 45]), with a margin of error of ±2 points. Pre-training, the mean UAS knowledge score was 56.00 ($SD = 21.833$), increasing to 86.50 ($SD = 6.258$) post-training, indicating a significant improvement. These results support H4, affirming a substantial enhancement in UAS knowledge levels among officers with an associate degree following the training.

Hypothesis 5

H5: Posttest-training scores from the UAS response and investigation training delivered to a sample of DBPD officers with a bachelor's degree as their highest level of education will be higher than pretest-training scores.

A paired samples t-test compared the UAS knowledge scores of DBPD officers with a bachelor's degree before and after UAS response and investigation training, showing a significant difference ($t(6.744) = 4.395$). From a sample of 22 officers, the estimated mean pre- and post-test scores were 29.773 (95% CI [21, 39]), with a margin of error of ±2 points. Before training, the mean UAS knowledge score was 58.18 ($SD = 20.210$), increasing to 87.95 ($SD = 6.484$) post-training, indicating a significant improvement. These results support H5, highlighting a notable enhancement in UAS knowledge levels among officers with a bachelor's degree following the training.

Hypothesis 6

H6: Posttest-training scores from the UAS response and investigation training delivered to a sample of DBPD officers with a master's degree as their highest level of education will be higher than pretest-training scores.

A paired samples t-test compared the UAS knowledge scores of DBPD officers with a master's degree before and after UAS response and investigation training, revealing a significant difference ($t(7.504) = 5.663$). From a sample of 14 officers, the estimated mean pre- and post-test scores were 42.50 (95% CI [30, 55]), with a margin of error of ±2 points. Pre-training, the mean UAS knowledge score was 46.79 ($SD = 20.344$), rising to 89.29 ($SD = 6.157$) post-training, indicating a significant improvement. These results support H6, indicating a substantial increase in UAS knowledge levels among officers with a master's degree following the training.

Hypothesis 7

H7: Posttest-training scores from the UAS response and investigation training course delivered to a sample of DBPD sergeants, lieutenants, captains, and chiefs will be higher than pretest-training scores.

A paired samples t-test was conducted to assess the mean UAS knowledge scores of DBPD sergeants, lieutenants, captains, and chiefs before and after UAS response and investigation training, revealing a significant difference ($t(7.780) = 5.222$). From a sample of 16 officers, the estimated mean pre-and post-test scores were 40.625 (95% CI [29, 52]), with a margin of error of ±2 points. Pre-training, the mean UAS knowledge score was 49.06 ($SD = 20.430$), rising to 89.69 ($SD = 7.181$) post-training, indicating a significant improvement. These results support H7, indicating a substantial increase in UAS knowledge levels among DBPD sergeants, lieutenants, captains, and chiefs following the training.

Hypothesis 8

H8: Posttest-training scores from the UAS response and investigation training delivered to a sample of DBPD officers with 0-5 years of service with the DBPD will be higher than pretest-training scores.

A paired samples t-test was employed to compare the mean UAS knowledge scores of DBPD police officers with 0-5 years of service before and after UAS response and investigation training, revealing a significant difference (t(11.561) = 2.663). From a sample of 57 officers, the estimated mean pre- and post-test scores were 30.789 (95% CI [25, 36]), with a margin of error of ±2 points. Pre-training, the mean UAS knowledge score was 57.81 (SD = 19.888), increasing to 88.60 (SD = 5.240) post-training, indicating a significant improvement. These results support H8, suggesting a notable increase in UAS knowledge levels among DBPD police officers with 0-5 years of service following the training.

Hypothesis 9

H9: Posttest-training scores from the UAS response and investigation training delivered to a sample of DBPD officers with 6-10 years of service with the DBPD will be higher than pretest-training scores.

A paired samples t-test was conducted to compare the mean UAS knowledge scores of DBPD police officers with 6-10 years of service before and after UAS response and investigation training, revealing a significant difference (t(5.792) = 7.424). From a sample of 10 officers, the estimated mean pre- and post-test scores were 43.00 (95% CI [26, 60]), with a margin of error of ±2 points. Pre-training, the mean UAS knowledge score was 48.00 (SD = 22.509), increasing to 91.00 (SD = 5.164) post-training, indicating a significant improvement. These results support H9, suggesting a substantial increase in UAS knowledge levels among DBPD police officers with 6-10 years of service following the training.

Hypothesis 10

H10: Posttest-training scores from the UAS response and investigation training delivered to a sample of DBPD officers with ten years or more of service with the DBPD will be higher than pretest-training scores.

A paired samples t-test compared the mean UAS knowledge scores of DBPD officers with ten years or more of service before and after UAS response and investigation training, showing a significant difference (t(8.968) = 4.646). From a sample of 15 officers, the estimated mean pre- and post-test scores were 41.667 (95% CI [32, 52]), with a margin of error of ±2 points. Pre-training, the mean UAS knowledge score was 47.00 (SD = 18.400), increasing to 88.67 (SD = 6.114) post-training, indicating a significant improvement. These results support H10, indicating a notable increase in UAS knowledge levels among DBPD officers with ten years or more of service following the training.

Analysis & Discussion

Using paired samples t-tests, 82 DBPD officers with diverse demographics and educational backgrounds (high school diploma, associate degree, bachelor's degree, and master's degree) were evaluated to see whether the online training they participated in affected their knowledge base and self-efficacy by comparing their pre-training test scores with their post-training test scores. According to the data, online training substantially increased UAS knowledge scores across all education levels, with large effect sizes. In addition, officers with higher levels of education had higher post-test scores. Implementing the UAS response and investigation training resulted in a substantial increase in the UAS knowledge and confidence of police officers, confirming the hypotheses and answering the research questions.

Training and adherence to constitutional principles are essential, as demonstrated by legal precedents such as *Monell v. Department of Social Services* (1978) and *Popow v. City of Margate* (1979). In 1978, the Department of Social Services established the municipal liability doctrine in civil rights cases against local government entities. Local governments could be held liable for constitutional violations caused by their policies, practices, or customs, making it easier for individuals to seek redress for civil rights violations by municipalities and prompting changes in government practices to prevent them (*Monell v. Department of Social Services,* 1978). In 1979, the courts emphasized the need for law enforcement firearms training to reflect real-world conditions. In *Popow v. City of Margate*, an officer accidentally shot and killed Mr. Popow while pursuing a suspect. The court found the officer's training grossly inadequate, lacking instruction on low-light conditions, moving targets, and firing in residential areas (*Popow v. City of Margate*, 1979). This case underscores the imperative for police departments to furnish their officers with essential training tailored to the situations they may encounter during their official duties.

When addressing UAS operations, developing comprehensive policies and procedures becomes imperative. This process begins with educating police department administrators and other local, state, and federal agencies. Collaboration between all agencies that have the potential to work in a jurisdiction is critical for success. Ongoing education, training, collaboration between officers and dispatch personnel, and the integration of community policing principles contribute to an effective response to UAS incidents (FAA, 2022c). Public education initiatives and community partnerships further enhance compliance with FAA regulations and promote trust between law enforcement and the community. Addressing UAS challenges requires a comprehensive approach that prioritizes education, training, community collaboration, and adherence to FAA regulations. By implementing these strategies, police departments can respond effectively to UAS incidents, foster stronger community relationships, and promote public safety (FAA, 2018).

It is imperative that police departments establish a mandatory requirement for UAS response and investigation training across all officer ranks due to the effectiveness of the training. This training should be mandatory for all law enforcement agencies in the United States, as this emerging technology can be used for criminal purposes, such as when police officers must respond and investigate during normal patrol activities. The FAA has provided limited guidance to police departments on the fundamental steps for responding to UAS operations. Police departments must educate and train their police officers of all ranks and experience levels before they engage with UAS operators in the field due to the natural complexity of aviation regulations and potential jurisdictional issues that arise when addressing UAS operations (FAA, 2018).

The findings from this study provide evidence of a significant positive difference between the mean UAS knowledge scores before and after the UAS response and investigation training. The posttest knowledge test scores were significantly higher than the pretest knowledge test scores. This study also discovered that the performance of DBPD officers who participated in the online training improved significantly, regardless of the officers' education level, rank, or length of service.

In light of the constant evolution in the field, police officers must undergo specialized UAS response and investigation training to effectively address the UAS calls they are likely to encounter during their tour of duty. To ensure the continued significance of this training, police departments should offer routine refresher courses while expanding the curriculum to encompass various real-world UAS scenarios and recent regulatory advancements. Given the mandatory familiarity with the NAS, FAA regulations, and pertinent aviation state statutes, the significance of ongoing and current training in responding to and investigating UAS incidents cannot be overstated. More extensive and diverse study samples are recommended for a more comprehensive evaluation of the program's impact and long-term studies on training outcomes.

It is crucial to highlight the importance of establishing efficient officer feedback systems and community involvement mechanisms concerning the execution and continuation of UAS training programs designed for police officers. Given that these training efforts are focused on providing officers with the essential abilities to address UAS operations proficiently, it becomes imperative to uphold an ongoing avenue of communication connecting training coordinators, officers, and the local communities they serve. Integrating officer feedback mechanisms allows those directly engaged in the training to provide insights into its effectiveness, practicality, and relevance in real-world scenarios. Police officers on the frontlines possess invaluable insights into the challenges they encounter when dealing with UAS incidents, and their input can contribute to refining the training content, ensuring it addresses the most pertinent issues they face. Regular surveys, focus groups, and open discussions can allow officers to share their experiences, suggest improvements, and voice concerns.

Moreover, establishing robust community engagement strategies alongside officer feedback mechanisms can bridge the gap between law enforcement and the public. As UAS technology continues to influence various aspects of society, police officers need to be attuned to community-specific concerns and expectations regarding using UAS. Law enforcement agencies can better align the training content with community needs and expectations by involving community members, local stakeholders, and advocacy groups in the training development and evaluation.

Limitations

Several limitations may be associated with the study population, stemming from factors such as sample size, selection process, or participant characteristics. The delivery of online questionnaires, training, and testing materials relied on a self-paced online training video and an internet browser. This approach could potentially introduce bias, particularly among participants lacking experience with computers and computer-based training, thereby influencing research outcomes. Additionally, the reliance on self-reported self-efficacy levels from participants regarding UAS incident response may introduce subjectivity into the results. The study exclusively focused on DBPD officers, limiting the generalizability of findings. Moreover, participants could not seek clarification or ask questions about the material presented in the online training video, potentially impacting the comprehensiveness of the training and, consequently, the study's outcomes.

Conclusion

The integration of technology into the community contributes to the dangers faced by police officers during routine patrols in the 21st century. The research evaluated how practical the UAS response and investigation training was in enhancing police officers' understanding and confidence regarding responding to and handling UAS incidents. The study focused on the DBPD, where 82 officers voluntarily participated in a self-selection sampling method, ensuring diverse perspectives were included. Data was collected through questionnaires, surveys, pretests, online training modules, and posttests. The study analyzed different research questions and hypotheses, comparing participants' pretest and posttest scores through paired samples *t*-tests. Encouragingly, all groups, regardless of educational backgrounds, rank, and service years, showed significant improvement in UAS knowledge and self-efficacy confidence after completing the training, with notably large effect sizes.

Recommendations for Practice

This study is beneficial for police administrators responsible for providing mandatory training required to equip officers with the correct tools to perform their everyday duties as police officers. This study may provide police administrators with the data and findings necessary to justify the implementation of this training to their superiors. By providing this training, police administrators can reduce their agency's liability. The results of this study may be utilized to demonstrate the validity of the training to other police organizations so that it can be implemented in police agencies across the United States.

This study is also advantageous for those UAS operators who are lawfully operating their UAS in the NAS since they will engage with police who respond to and investigate UAS occurrences effectively without violating UAS operators who operate legally. The results of this study may inform police officers, police executives, and criminal justice researchers how to improve UAS response and investigation training throughout the United States. The results may also inform policymakers and executive law enforcement leaders how they can provide critical support and training for their officers through legislative and departmental policy actions.

Recommendations for Future Research

The results of this study may be utilized to demonstrate the validity of the training to other police organizations so that it can be implemented in police agencies across the United States. Multiple paths for future research have surfaced since the beginning of our study and results from the data. In addition to a more extensive and diverse sample, future research projects should consider involving multiple police departments nationwide. Collaborative efforts across various jurisdictions would not only enrich the research findings but also provide a broader perspective on the efficacy of the training program in different operational environments and legal frameworks. Researchers can gain insights into how the program's impact varies across contexts by involving departments with varying UAS-related incidents, operational sizes, and training practices. Furthermore, to gain a more comprehensive understanding of the long-term effects of the training program, subsequent research should consider conducting longitudinal studies. Tracking the performance and responses of officers over an extended period would enable researchers to gauge the durability of the training outcomes and assess whether the acquired knowledge and self-efficacy improvements are maintained over time. Also, future research should explore long-term effects and contributing factors to validate these findings further.

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APPENDIX A: Questionnaire

Self-efficacy Questionnaire (Pre-Training & Post-Training)

This questionnaire is designed to help us better understand how police officers understand concepts and tasks associated with responding to UAS/drone incidents while on duty.

Please rate your degree of confidence by recording a number from 0 (cannot do) through 100 (certain can do) of how confident you think you are at the following items.

1. Knowledge of Daytona Beach Police Department (DBPD) Uncrewed Aircraft System (UAS) policy	
2. Knowledge of applicable federal UAS/drone laws	
3. Skill to successfully apply federal UAS/drone laws	
4. Knowledge of applicable state UAS/drone laws	
5. Skill to successfully apply state UAS/drone laws	
6. Knowledge to identify a UAS/drone	
7. Knowledge to identify legal UAS/drone operations	
8. Knowledge to identify illegal UAS/drone operations	
9. Skill to find the UAS/drone operator	
10. Knowledge of what questions to ask the operator to determine the type of UAS/drone flight (recreational, part 107, public safety)	
11. Knowledge of Federal Aviation Administration (FAA) Airspace	
12. Knowledge of the proper UAS response continuum	
13. Knowledge of the required UAS response documentation process and completion	

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An Examination of the Current State of Examining Authority at Part 141 Pilot Schools

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In recent years, the airline industry pilot base has experienced significant turnover. As a result, there has been a corresponding need for qualified pilots to fill open pilot positions, therefore an increased need to train and certificate those pilots. A main source for training larger numbers of pilots has been FAA part 141 pilot schools. Most of the part 141 pilot schools train student pilots to proficiency and send those students to a FAA Designated Pilot Examiner for the check ride. A much lower number of part 141 pilot schools are approved for Examining Authority, which allows the school itself to conduct rating and certificate check rides in house. The process for a school to receive FAA approval is outlined in FAR 141.63 and 8900.1, and in some ways, appears to be open for interpretation. The purpose of this study was to examine the perceptions of process requirements associated with FAA Examining Authority approval. The study also aimed to investigate the different Examining Authority approval requirements as set forth by individual Flight Standards District Offices. In addition, the researchers sought to discover whether pilot schools who perceived Examining Authority approval to be too difficult to pursue, would reconsider if those requirements were easier to obtain. A survey was conducted with part 141 pilot schools to gain an understanding of school perceptions of the process, and to examine whether individual FSDOs follow the same process and expect the same requirements. Survey findings showed that there were significant differences in Examining Authority approval requirements between different FSDO offices. Additionally, several pilot schools stated that they would consider, or reconsider application for Examining Authority if the FAA relaxed some approval requirements.

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Introduction

A steep increase in airline hiring has contributed to a shortage of available, qualified pilots. According to Hardee (2023), projections show a cumulative industry-wide deficit of pilots in North America to exceed 13,000 by 2032. As a result, pilot schools across the country have seen a rise in the number of pilot applicants and a corresponding increase in the number of practical tests needed to keep pace. To obtain a pilot certificate, an applicant must pass a practical test administered by a Federal Aviation Administration (FAA) representative. Currently, there are three ways a practical test may be administered. One option is that a test may be administered directly by an FAA inspector. Of the 105,000 practical tests performed in 2021, less than 1% were conducted by FAA inspectors (Beckman et al., 2023). The second option and most common way that practical tests are obtained is through an FAA Designated Pilot Examiner (DPE) (Federal Aviation Administration [FAA], 2023a). A DPE is an individual appointed in accordance with 14 Code of Federal Regulations (14 CFR) Section 183.23, who meets the qualification requirements of Order 8900.2, General Aviation Airman Designee Handbook (FAA, 2018).

The local Flight Standards District Office (FSDO) determines the number of DPEs designated by the need in their area of geographic responsibility, along with a determination of the office's ability to manage each DPE. DPEs assigned to a particular district office should be able to provide practical tests within a "reasonable period of time" (FAA, 2018, pp. 2-3). The ability to manage DPEs is determined by staffing and funding of individual district offices, which often affects the number of DPEs designated in a particular area (Beckman et al., 2023). Individual DPE availability to conduct practical tests is varied. Some DPEs are full-time and able to complete practical tests consistently. Other DPEs are part-time and conduct practical tests in and around other obligations. It is estimated that approximately half of current DPEs do only one practical test per week (Godlewski, 2022). This varied availability among DPEs does not allow for a consistently reliable way to process large numbers of flight students through the practical test process.

Beckman et al. (2023) examined the DPE system and gathered the perceptions of flight training providers regarding the use of DPEs for pilot practical tests. Results of the authors' study showed that 60% of responding flight training providers indicated their pilot applicants were waiting for a practical test with a DPE for three weeks or more. Of responding flight schools, 35% indicated that these wait times were somewhat of an issue, and 49% indicated it was a significant issue for their students. When asked if there were enough DPEs in their region to complete the required number of pilot practical tests, 83% of responding flight training providers indicated there were too few DPEs to meet demand. The authors reported that there were 851 DPEs available to provide pilot practical tests in 2021, and they completed 87% of all practical tests that year. Results of this study indicate that flight training providers perceive the DPE system as unable to meet the practical test demand of their students.

The third option for student pilot practical tests would be if the student was enrolled in a 14 CFR Part 141 pilot school approved by the FAA to conduct practical tests in-house through an examining authority (FAA, 2021). Examining authority is granted to a pilot school that has applied through the FAA and meets the following specific qualification requirements; the school must hold a pilot school certificate and rating issued under 14 CFR Part 141.63; the school must have held the rating in which examining authority is sought for at least 24 consecutive calendar months preceding the month of application for examining authority; the course must meet the minimum ground and flight training requirements of 14 CFR Part 141.63; within 24 calendar months before the date of application for examining authority, that school must have trained at least 10 students in the training course for which examining authority is sought and recommended those students for a pilot, flight instructor, or ground instructor certificate or rating; at least 90 percent of those students passed the required practical or knowledge test, or any combination thereof, for the pilot, flight instructor, or ground instructor certificate or rating on the first attempt, and that test was given by an FAA inspector, or an examiner who is not an employee of the school (Examining Authority, 2024).

As previously reported, there were 851 DPEs approved to conduct practical tests in 2021, which accounted for 87% of the total practical tests. The remaining 13% of the practical tests were conducted through flight schools that were approved for 14 CFR Part 141 examining authority. Of the 2,200 flight training providers in the United States, 877 are 14 CFR Part 141 approved providers, and of those schools, only 58 (6.5%) are approved for examining authority for at least one flight course (Beckman et al., 2023). A pilot school with examining authority has the authority to recommend its graduates for pilot certificates or ratings without further testing by the FAA (FAA, 2021). These schools can be more consistent with their students' practical tests, as they are subject to their own schedules and have their own FAA-approved personnel on staff.

Additional guidance, beyond 14 CFR Part 141.63, found in FAA Order 8900.1, Volume 5, Chapter 121, states that "after receiving an application for examining authority from a 14 CFR Part 141 pilot school, the local FSDO should conduct the FAA practical test for at least 50 percent of the graduates of the course for which the school applied for examining authority" (FAA, 2007, p.1). The verbiage of this statement indicates that FSDO participation in practical tests is not a regulatory requirement but rather an advisement of practice. Some FSDOs may view the 8900.1 statement as regulatory, while others may not. If FSDOs are not adequately staffed to conduct high numbers of practical tests, and those FSDOs view the 50 percent number as regulatory, those offices may be unable to ensure the initial practical tests required for examining authority approval will be conducted in a reasonable period of time as outlined in 8900.2. A result of this could be that some FSDOs may not consider applications for examining authority at all. This would preclude the pilot school from obtaining examining authority and, in some cases, could cause pilot schools to forego the examining authority application process entirely. Different FSDO interpretations of 8900.2 may have a direct effect on examining authority application and/or approval.

The purpose of this study is to examine the current state of examining authority at 14 CFR Part 141 pilot schools and any possible impediments these schools are experiencing in securing examining authority. Beckman et al. (2023) examined perceptions of flight training providers regarding the current state of the DPE system. We hope to look at another aspect of the practical test options with this examination of examining authority. The authors are former 14 CFR Part 141 pilot school chief flight instructors with experience with the processes and challenges of being awarded examining authority. Conversations with other current chief flight instructors of 14 CFR Part 141 pilot schools, combined with our experiences, provide anecdotal evidence regarding these processes and challenges. This study examines the perceptions of pilot school chief flight instructors regarding the requirements, process, and possible impediments to obtaining examining authority in their FSDO region.

Methodology

This study examines the perceptions of pilot school chief flight instructors regarding the requirements, process, and possible impediments to obtaining examining authority in their FSDO region. The population for this study was all 14 CFR Part 141 pilot school chief flight instructors in the United States. The primary research questions that directed this study were:

1. What is the current state of examining authority among 14 CFR Part 141 pilot schools?
2. What issues are 14 CFR Part 141 pilot schools contending with in their pursuit of examining authority?
3. What are the perceptions of 14 CFR Part 141 pilot school chief flight instructors regarding the requirements for and process of attaining examining authority?

To examine these questions, a survey instrument was developed. Discussions were held with former and current 14 CFR Part 141 pilot school chief flight instructors to gain insight into the process and requirements of applying for examining authority and any challenges their schools experienced in the application process. These discussions led to the development of the survey questions. The survey instrument consisted of 25 questions employing several different question types. The first five questions addressed informed consent, with the remaining questions designed to collect information about the respondents' flight school, including courses offered, number of student applicants for the flight courses the school offered, size of their fleet, number of flight instructors, and size of the staff. Sixteen questions were designed to capture quantitative data, while four were open-ended questions designed to capture the respondent's insights and perceptions. Demographic questions identified the FSDO region that provided oversight to the flight training provider. Questions examined the schools' eligibility for examining authority as described in Subpart D of 14 CFR Part 141 and about the school's current examining authority status, if the school had examining authority, or if they were pursuing or planning to apply for examining authority. Respondents were asked to identify the flight courses for which they were pursuing or planning to pursue examining authority. We then asked about any additional requirements that went beyond Subpart D of 14 CFR Part 141. Specifically, we asked if those who have applied for examining authority were required by their FSDO to follow the guidance found in Document 8900.1 that the local FSDO should conduct at least 50% of all practical tests of the graduates of the course for which the school applied for examining authority.

Because of anecdotal evidence that suggested guidance found in FAA Order 8900.1 was not applied consistently, questions that addressed a school's experience with their FSDO regarding this guidance were included in the survey. Respondents were then asked about their perceptions of the application process and about factors that may change their stance on their pursuit of examining authority. Participants were asked if relaxing the requirements for examining authority would make them more likely to pursue the authority. We inquired about requirements from their local FSDO for check instructors and the training process and requirements for check instructors. Respondents were provided opportunities, through open-ended questions, to discuss specific issues related to their pursuit of examining authority.

The instrument was reviewed by three individuals who were knowledgeable about the topic to provide face validity. These individuals included two chief flight instructors and one individual with extensive research experience in developing survey questionnaires. Feedback from these reviewers was incorporated into the survey. Because this study involved human participants, the research team applied for and was awarded an exemption from the Institutional Review Board (IRB).

A search of the Aircraft Owners and Pilots Association (AOPA) Flight School Finder (2023) provided contact information for participants. Because the site contains information about many kinds of flight training providers, it allows for filtering to identify the characteristics you may be looking for. The site lists fixed-wing (airplane), rotorcraft (ex. helicopter), lighter-than-air (ex. balloon) flight schools, as well as flight schools that provide flight training under the provisions of 14 CFR Part 61 and 14 CFR Part 141 pilot schools. The search provided email contact information for 457 14 CFR Part 141 pilot schools and included all 14 CFR Part 141 flight training providers, whether they conducted airplane, rotorcraft, or balloon flight training. Because the majority of collegiate aviation program flight training is conducted under 14 CFR Part 141, the University Aviation Association (UAA) was asked to distribute the survey to its membership.

Results

The link to the electronic survey instrument, which was developed in Qualtrics XM online survey software, was sent to all 457 14 CFR Part 141 pilot schools identified in the Aircraft Owners and Pilots Association Flight School Finder and to all UAA institutions. Two weeks after the initial invitation email, a reminder email was sent to the 457 pilot schools and to the UAA institutions, asking for the chief flight instructors to complete the survey. After another two weeks, the survey was closed in Qualtrics, and the data were compiled. Of the 457 emails sent, 22 were returned as undeliverable, making the total number of potential recipients 435. Valid responses to the survey were received from 53 participants, which made the response rate 12.2%. Respondents represented 29 of the 76 FSDO regions. Of the respondents, 12 (22.67%) indicated they had examining authority for at least one flight course offering, with 41 respondents (77.36%) indicating they did not have examining authority for any course offered. Of respondents who indicated their school had examining authority, nine indicated they had the authority for ten years or less, with three indicating they have had the authority for 11 years or greater. Twelve participants indicated that they were in the application process for examining authority, with 27 indicating they were not pursuing the authority. All participants who indicated they were in the application process indicated that they met the requirements outlined in 14 CFR Part 141 Subpart D. Participants were asked to identify the courses for which they were pursuing examining authority. Twelve schools were pursuing examining authority for the Private Pilot Airplane Single Engine Land (ASEL), one school had applied for examining authority for their Private Pilot Airplane Multiengine Land (AMEL) course, 12 respondents indicated they had submitted their Instrument Airplane course, with seven indicating they had submitted their

Commercial Pilot ASEL course, five submitted their Commercial AMEL, and two pilot schools had applied for examining authority for their Certified Flight Instructor (CFI) ASEL course.

Of the 12 respondents who indicated they were pursuing examining authority, four stated they were required by their local FSDO to meet requirements in addition to those listed in 14 CFR Part 141 Subpart D, while 8 indicated their local FSDO did not require them to meet any additional requirements. When we asked specifically if they were required to have their local FSDO observe or conduct 50% of all practical tests in a cohort of students during their application process, five indicated yes, while six indicated they were not. These two questions in the survey were meant to gauge the application of the guidance in FAA document 8900.1.

We asked respondents to indicate the number of applicants they recommend for a certificate or rating under 14 CFR Part 141 in a typical year. Responses indicated that the largest number of applicants were private pilots and airplane single-engine lands (ASELs), with a maximum of 200 reported and a minimum of one reported applicant. The Instrument Rating – Airplane and the Commercial Pilot, Airplane Multi Engine Land (AMEL) represent the next largest number of applicants, with 180 annually for each and a minimum of one and two, respectively. Table 1 presents the results for all certificates and ratings addressed in the survey.

Table 1
Number of Applicants per year by Certificate or Rating

Certificate or Rating	Number of Schools	Mean	Min	Max
Private ASEL	31	36.8	1	200
Private AMEL[a]	1	50	50	50
Instrument Rating - Airplane	30	40.4	1	180
Comm ASEL	21	26.6	1	120
Comm AMEL	11	52.7	2	180
CFI ASEL	6	43.2	4	140
CFI Instrument	6	14.8	2	40
CFI AMEL	3	20.3	1	40
Private Rotorcraft	3	27.3	2	60
Comm Rotorcraft	3	73.3	20	150
Instrument Rating Rotorcraft	3	24.0	12	40
CFI Rotorcraft	3	6.3	1	10

Note. Only one respondent indicated they recommended any students for the Private Pilot Airplane Multi Engine Land certificate.

Participants were asked if relaxing any of the requirements from the FAA would make them more likely to apply for examining authority; 17 (45.95%) answered yes, while 10 (27.03%) answered no. Open-ended questions were used to gather respondents' perceptions of areas of difficulty related to the pursuit of examining authority. The responses to these questions were far-ranging. One such question asked, "In pursuing examining authority, did your FSDO require you to satisfy requirements in addition to those listed in 14 CFR Part 141 Subpart D?" Nine respondents answered this question. One replied that their FSDO "wanted to conduct intermediate Stage Checks" and that they needed to demonstrate a need for examining authority due to a lack of DPEs. Another open-ended question asked, “What requirements by your FSDO are problematic in your pursuit of or intent to pursue examining authority?” Chief flight instructors from 16 schools responded to this question. Several participants indicated the local FSDO office struggled to provide the personnel to oversee the application process and complete any practical tests or observations they required. Responses included, “Our FSDO is so slow, we are not motivated to pursue examining authority.”. Another responded, “Local FSDO claims they don’t have enough personnel to allow us to test again. No oversight, so we cannot apply”. Another stated, “FSDO is understaffed and cannot address our application.”. Still, another’s response was, “Our FSDO responded to our request for examining authority by stating they "unable to approve examining authority due to resources available." In the same kind of response, another respondent stated, “Our FSDO is very understaffed and will not look at our application package.”

Another area expressed in these responses addressed the required pass rate required to meet eligibility for examining authority. Of particular concern was the 90% first-time pass rate required by 14 CFR Part 141 Subpart D and attaining that rate while dependent on Designated Pilot Examiners. One respondent stated, “…the local DPEs failed more students when they were notified, we applied for examining authority”. Another responded with, “We sat at 89% for over a year, but it would take 5-6 passes without fail to tip over that 1%. One fail in there would drop us back down. Another challenge to our pursuit of Private Pilot examining authority is the wide range of DPE personalities. So much can go wrong on a student's first checkride, so a DPE that starts a checkride by making an applicant more uncomfortable than necessary really sets them up for failure".

Questions in the survey then addressed staffing needs and requirements as they related to having or anticipating having examining authority. When asked if being awarded examining authority would require the hiring of additional staff, of 36 respondents, 13 indicated they believed they would have to hire additional staff. Fourteen respondents expected additional staff would not be needed. Nine schools indicated they were required by their FSDO to have a formal training program for any check instructors, while five indicated a training program was not required.

Discussion and Conclusions

Examining authority is not a good fit for every 14 CFR Part 141 pilot school. The results of this study indicate that 41 of the 53 (77.36%) responding to 14 CFR Part 141 pilot schools do not have examining authority. This supports the findings reported by Beckman et al. (2023). Of the 27 14 CFR Part 141 pilot schools that indicated they were not pursuing examining authority, 25 were smaller schools with no more than 20 pilot applicants completing a practical test in a year. The remaining two schools indicated they had no more than 40 pilot applicants in a year. Size may matter. Five of the schools represented in this study without examining authority indicated they would benefit from having the authority; however, they found significant impediments to attaining it.

Results suggest a disparity in the eligibility requirements beyond those listed in 14 CFR Part 141 Subpart D that the respondents pursuing examining authority were required to meet.

Document 8900.1 represents guidance for FSDO personnel; however, it is not regulatory in nature (FAA, 2007). The guidance for 50% of all practical tests to be conducted by the local FSDO was not applied universally. Of the 12 respondents who answered the open-ended question, seven indicated that a relaxation of the requirements to obtain examining authority would encourage them to pursue the authority. Of the 15 respondents who answered the question, nine indicated that their FSDO did not have the personnel to satisfy the 50% requirement of 8900.1 and, therefore, could not conduct or observe 50% of practical tests. This suggests that those FSDOs viewed 8900.1 as more regulatory in nature.

The varied availability of DPEs does not appear to lend itself to the consistency needed to meet the high demand for practical tests. As industry demand for available pilots grows and the number of pilot applicants continues to rise, it is possible that the number of DPEs required to meet that demand will not keep pace. If the number of practical tests required remains, and the backlog that is taking place at many pilot schools continues, an alternative means to DPEs may be desirable to move pilots through the examining process more efficiently.

The purpose of this study was to examine the current state of examining authority at 14 CFR Part 141 pilot schools and any possible impediments these schools are experiencing in securing examining authority. This study has opened additional avenues to pursue as we continue to dig deeper into the topic. As reported by Beckman et al. (2023), flight training providers perceive the DPE system as unable to meet the practical test demand for their students. It would stand to reason that if more 14 CFR Part 141 pilot schools were approved for examining authority, it might contribute to meeting the demand in a more efficient manner than is currently being met by the DPE base. Some schools have decided to pursue examining authority to help with this issue, while others, for one reason or another, have not. Examining authority is not necessarily a good fit for every 14 CFR Part 141 pilot school. Many of the schools that participated in this study indicated that they were not interested in pursuing examining authority and listed different reasons for this.

Limitations of the Study

Because of the design and methodology of this study, certain limitations impact the results and conclusions. A limitation of this study is the use of an online survey instrument for data collection. A personal interview with each respondent may have provided a more thorough discussion of the topics examined in the study; a survey forces a selected response that may not reveal specific information available through an interview. The survey was distributed using email, which may have led to potential respondents ignoring the email and not completing the survey, ultimately impacting the response rate. Time constraints may have played a role in this study. Those who received the invitation email may have felt that they could not spare the time required to complete the survey and elected not to participate. Participants may have misunderstood questions, leading to misleading responses.

To lessen the potential impact of these limitations, we focused our attention on the structure and design of the survey. We invited subject matter experts, in the form of current 14 CFR Part 141 chief flight instructors, to review the survey instrument and provide feedback about the specific questions included in the survey and the topics addressed. We also had the survey reviewed by a highly accomplished researcher with extensive experience developing and administering survey instruments. Feedback from these individuals was used to refine the survey. To assuage concerns about the amount of time a participant may take to complete the survey, the invitation email included an estimate of the time required to complete it.

Future Research

Responses to the open-ended questions in the survey have provided insight into additional topics of investigation for future study. The research team has started work on a follow-up study to examine these topics more deeply. Data for this study were collected during the summer of 2023; on September 26, 2023, the FAA published Notice 8900.675, which rescinded the guidance in 8900.1 that for a school seeking examining authority, the local FSDO should conduct 50% of all practical tests for applicants in the course for which examining authority was being sought (FAA, 2023b). The research team includes questions in the follow-up study to examine the impact of this change on the intent of 14 CFR Part 141 pilot schools to pursue examining authority.

The results captured in this study offer a partial view of the current state of examining authority at 14 CFR Part 141 pilot schools. Because this study focused on the flight training providers, the FAA's perspective was not investigated. It would be appropriate to query the FSDO personnel who oversee the 14 CFR Part 141 pilot schools in their area of jurisdiction and gain their insight into the issues examined in this study. We hope this will provide a balanced view of the process and any challenges parties on both sides of the process face.

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Quieted Voices: A Phenomenological Analysis of The Experiences of Black/African-American Collegiate Aviation Students

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The aviation industry lacks racial and gender diversity. It is White-male dominated, with 94% of professional pilots identifying as White males, only 3.4% identifying as Black Americans, and less than 5% are female. Research focusing on the participation rates and experience(s) of Black Americans in aviation is scant. The purpose of this study was to understand the experience(s) of Black American collegiate aviation students so higher education and aviation industry leaders could make informed policy decisions and rectify inhospitable work environments, respectively. A phenomenological approach was used to capture the phenomenon via semi-structured interviews of 10 participants. The study revealed three major battles Black aviation students fight due to external and/or internal pressures, which significantly impact their collegiate experience(s) and, to a certain degree, retention. Being a Black woman or a "double only" in an underrepresented space yielded an experience that Black males were unaware of and did not experience but made the collegiate experience of a Black woman very different than that of their male counterparts. Additionally, a student's involvement in a community of support seemed to be a notable difference-maker in one's collegiate experience(s). These communities provided salient socio-emotional support for students, helping reduce instances of social isolation and assimilation many of the participants described. Pointed recommendations on how to improve the retention of Black students and Black Americans in collegiate aviation programs and the aviation industry, respectively, were furnished to conclude the study, which were aimed at higher education and industry leadership.

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Introduction

The U.S. workforce currently employs approximately 147,795,000 individuals across various industries with 300,000 working in the transportation sector (Bureau of Labor Statistics [BLS], 2021). Despite the increased diversification in the workforce over the past two decades, the diversity within the transportation sector has not experienced a similar trend in terms of race/ethnicity or gender (BLS, 2021). This is reflected within the aviation industry as it is White-male dominated, with 94% of pilots identifying as White while only a mere 3.4% identify as Black or African-American (referred to from this point forward as Black American(s)). When factoring in gender, less than 5% of airline pilots are female (Lutte, 2021a). An aging workforce and increased demand for commercial air travel have only exacerbated this issue, forcing many public and private sector entities to act (Lutte, 2021a). Albeit outreach efforts have been made by commercial airline operators, Black Americans are reluctant to enter the aviation industry, perhaps due to financial and social barriers, lack of awareness of aviation-related opportunities, and lack of representation, as suggested by interviews with Black American corporate pilots (Harl & Roberts (2011).

There has been very little research focalizing the participation rates of minorities in aviation and studies centralizing Black Americans in particular. There has also been little recent research with special emphasis on phenomenological studies conducted to understand the experiences of racial/ethnic and gender minorities in aviation or other STEM fields or studies conducted to explore the underpinnings of the lackluster racial diversity endemic to the aviation industry (Molloy, 2019; Kim & Albelo, 2020). The focus of the study by Molloy (2019) was to understand what it meant to be an underrepresented student in a collegiate aviation flight program via a phenomenological approach utilizing interviews, focus groups, questionnaires, and journal reflections. The impetus of Molloy's study stemmed from the lack of studies exploring the lived experience of being an underrepresented student in a collegiate aviation program, although some qualitative studies were conducted on undergraduates majoring in other STEM fields (Molloy, 2019). The focus of the research conducted by Kim and Albelo was to heighten awareness of race equality and gender in aviation within higher education to ultimately underscore factors that contribute to the academic success of minority women in aviation (Kim & Albelo, 2020).

Building upon the aforementioned studies, the purpose of this study is to understand the academic and social experience(s) of Black American collegiate aviation students. It explores the lived experiences of a specific demographic of underrepresented students, Black Americans enrolled in collegiate aviation programs and expands beyond just professional pilot programs. Additionally, this study supplements the research conducted by Kim and Albelo by elucidating factors that impact the academic success of racial minorities, specifically Black American students (male and female). The central research question addressed is: What has been the experience(s) of Black American collegiate aviation students? The two secondary research questions are: What has been the academic experience(s) of Black American collegiate aviation students? What has been the social experience(s) of Black American collegiate aviation students?

Since research focalizing these experience(s) of Black Americans in aviation is scarce and with the notion of diversity, equity, and inclusion becoming a priority for many, it is paramount that these experiences be acknowledged and propagated. By sharing said experiences, recommendations to aid in the diversification of and enhance the aviation industry's ability to meet the increasing workforce demand may be discovered. Understanding these experiences may also aid in determining how a student's involvement in activities impacts retention within their aviation program and/or higher education in general. The rationale behind this is that involvement in activities or organizations may grant minority students access to pivotal services and programs that provide (peer) support or mentorship, financial support, and a sense of belonging (i.e., community). These factors may be difficult to find within their aviation programs, especially if located at a Predominantly White Institution (PWI). Further, they may be salient for academic and social integration within the collegiate environment, which has been suggested to increase their retention within higher education (O'Keeffe, 2013; Jama et al., 2009).

The following sections detail the literature review, which contextualizes the study and provides adequate background about the study's purpose. Following the literature review is the methodology section, which will describe the methodological procedures utilized to conduct the study, specifically detailing the data collection and explication methods as well as how data validity and trustworthiness were bolstered. The findings of the study are then presented, followed by a discussion of them. This study culminates with a description of where future research opportunities should be directed, the provision of robust recommendations for collegiate aviation administrators and aviation industry leaders, and a brief, conclusive statement about the study.

Literature Review

The literature review will be divided into four sections. The first section will review the underpinnings of the diversity issue that has impacted the diversification of many sectors and organizations. The second section will outline the progress Black Americans have made professionally in the U.S. despite the inequity and discrimination they have been subjected to in society. The third section will detail the previous attempts to bridge the diversity gap that exists in U.S. society. The fourth section will explicate the advancement of Black Americans in higher education and the aviation industry to provide an adequate backdrop for this study. This allows the researcher to properly situate the urgency and salience of the research for those not familiar with its underpinnings.

Underpinnings of the Diversity Issue

The current racial and gender workforce statistics surrounding the commercial aviation industry are concerning because possessing broad representation is integral for its longevity (Lutte, 2021a), which cannot be accomplished unless talent from underrepresented groups is sourced. However, sourcing this talent is easier said than done unless the latent underpinnings of diversity issues endemic to higher education and the aviation industry are addressed. One proponent of the aforementioned issue is that there is a lack of STEM graduates matriculating from undergraduate programs within the U.S. to fulfill essential STEM-related positions (Murillo, 2020). With this shortage now being recognized by scholars, researchers, and practitioners, pundits realize the U.S. will be unable to render ample graduates to meet the increasing demand to remain competitive in STEM fields unless swift action is taken. The lack of STEM graduates is exacerbated in relation to minorities because of low recruitment into said programs and poor retention, which is compounded by minority students voluntarily leaving STEM programs at a much higher rate than non-minority students (Murillo, 2020). Consequently, the impact of notably low recruitment and retention of minorities in STEM programs has significantly contributed to the lackluster number of minorities matriculating from collegiate aviation flight programs. Subsequently, the racial/ethnic and gender diversity of the aviation industry, especially the commercial sector, has been impacted significantly and, as a result, adversely affected the industry's ability to meet the workforce demand.

STEM programs encompass aviation and aerospace-related programs at the collegiate level, which has not always been the case as it was previously considered a vocation rather than a formal field of study (Halleran, 2019). This is imperative because collegiate aviation programs essentially serve as pathways to funnel recent graduates into various sectors of the aviation industry to meet the demand for management, professional pilot, maintenance, and other essential STEM-related positions pertinent to the industry. The implications of this graduation issue stem from other issues, such as lackluster exposure, inadequate representation, and ineffective marketing to certain demographics (National Research Council [NRC], 1997; Murillo, 2020). These three aforementioned issues constitute long-standing barriers to effective recruitment and retention within the industry (Murillo, 2020). Despite the many barriers that have impacted the participation rates of Black Americans in various industries, such as aviation, they have still made significant progress professionally.

Progression of Black Americans in the U.S.

Racial/ethnic and gender minorities have been historically repressed personally, academically, professionally, and socially. Racism and discrimination against racially minoritized citizens, especially Black Americans, have been endemic in the U.S., with the most axiomatic instances being slavery and Jim Crow laws (Cline, 2019). Simply, U.S. laws, policies, and organizations never considered racial equity a priority unless mandated by federal legislation, media pressure, or citizenry outcry. Black Americans have made substantial progress entering various industries of the workforce that are traditionally underrepresented, yet they still encounter significant racism, discrimination, and prejudice. However, some citizens in society believe that since Black Americans have experienced professional success, the U.S. has made notable progress toward racial equality/equity (Evans & Feagin, 2012). Such a belief is rooted in false maxims and ignorance. Albeit Black Americans have made monumental progress socially and professionally, racism and prejudice are still prevalent, and it is more sinister than ever since it is covert, embedded within certain policies and programs, dialogue, and administrative behaviors. There have been numerous attempts to 'bridge' the diversity gap throughout history, beginning in the early 1960s at the federal level to help Black Americans continue to progress and overcome certain unethical policies, processes, and programs.

Previous Attempts to Bridge the Diversity Gap

The era of 'Affirmative Action' marked the first holistic attempt to increase employment and educational opportunities for minorities, specifically for Black Americans. In 1961, President Kennedy used Executive Order 10925 to require federal contractors to take "affirmative action" to ensure applicants were treated equally regardless of race, color, religion, sex, or national origin. This legislation was predicated upon five premises, with the most prominent being to foster legal and social coercion to force change to pursue racial equity because women, Black Americans, immigrants, and other minorities were not allowed in certain spaces or professions due to widespread racial, ethnic, and sexual prejudice that consumed the country (American Association for Access, Equity and Diversity [AAAED], 2019; Thomas, Jr., 1990). Since its inception, affirmative action has aided an innumerable number of minorities in gaining entry to certain opportunities and into places that were historically scant, such as higher education and aviation. However, affirmative action on its own is not enough to redress the diversity disparity that exists within the U.S. workforce and society today, but it has served its purpose as the impetus for such a movement.

More recent research has noted that to build upon the impact affirmative action has had on helping minorities advance in society, robust partnerships between collegiate aviation programs and the commercial airline industry are needed. The NRC (1997) and Ison et al. (2016) recommended airline operators work aggressively to build linkage with aviation programs situated in Historically Black Colleges and Universities (HBCUs) as well as PWIs that possess large minority and female student bodies to increase the racial/ethnic and gender diversity of the applicant pool. This highlights the salience and necessity of pathway programs between the airline industry and collegiate aviation programs, as these programs will supply fresh graduates into the workforce with the knowledge, skills, abilities (KSAs), and qualifications necessary for the job. Furthermore, since most aviation outreach activities focus on pre-college age groups, a prime opportunity is missed that exists for outreach and support within collegiate institutions that enroll significant numbers of minority students in aviation education programs (NRC, 1997; Murillo, 2020). With the rising cost of college tuition coupled with the immense cost of flight training, financial assistance programs are necessary for aspiring aviators to pursue their dreams of taking flight, especially those identifying as low-income.

It is widely recognized that certain occupations within the aviation industry possess a high earning potential, such as professional pilots, but the financial burden of entering has served as an insurmountable roadblock for many students. The NRC (1997) recommended financial assistance programs be established for pilot positions to help applicants meet the costs of flight and transitional training. Such programs have proven to be beneficial, but financial support is desperately needed when these applicants are undergraduate students in pursuance of their initial certificates/ratings. Despite financial aid packages being offered by universities, they often do not cover the costs of aircraft rental, instructors, supplies, examination fees, and traditional coursework expenses. The fear is that if the immense cost of entering the aviation industry to become a professional pilot is not addressed swiftly within collegiate aviation programs, the industry's ability to meet the workforce demand will be exacerbated, and a unique, diverse talent pool will be further isolated. Despite the long-standing adversity and repression used to hinder Black American progression in the U.S., they have still made significant advancements in higher education and aviation.

Black American Advancement in Higher Education and Aviation

Tracking women and minorities within higher education, aviation, and collegiate aviation programs has seen lackluster effort for quite some time. Many scholars, researchers, and aviation experts contend the need to monitor the progress of underrepresented groups via trend analysis in postsecondary aviation education is paramount (Bowen, 1990; Ison et al., 2016). This is warranted because of the dearth of data collected regarding women and minorities in the aviation industry, scant research and literature about the topic, and the extremely low participation of these groups in STEM-related fields. Over the past 10-20 years, within collegiate flight programs, minorities comprised 27.3% of the student population, which exceeds the approximation of 18.4% participation rate within the profession (Ison et al., 2016). Additionally, research by Ison (2018) suggests minorities (including women) now make up 30% of the professional pilot program student body, which exceeds the participation rates in the industry, with 5.5% of pilots being minorities and 4.2% of pilots being women. This indicates the participation rates of minorities have experienced steady improvements over recent years, suggesting a high likelihood of continued advancement within higher education programs. Statistics such as 1.14% and 0.89% increase in Black men/women and Black men, respectively, between 1996 and 2007, contradict this notion (Ison, 2018). Albeit the trends in participation rates by minorities within aviation higher education are positive, overall participation rates of Black Americans indicate little progress. Thus, while there has been notable progress for minorities in higher education over the past several decades, these participation rates do not parallel those in the aviation industry.

The underrepresentation of minorities, specifically Black Americans, has been a persistent issue in many sectors for years. The aviation industry is no exception and is in desperate need of more Black pilots, maintenance technicians, aerospace engineers, etc. This is evident through research conducted by Lutte (2021a), which demonstrates that only 3.4%, 10.8%, and 6.8% of pilots, maintenance technicians, and aerospace engineers, respectively, identify as Black Americans. Part of this diversity disparity is because there has been little to no concern in understanding what the ‘lived experiences’ of Black Americans are, which also obscures the cognizance of racial barriers specific to them that hinder their advancement in aviation and STEM-related fields (Harl & Roberts, 2011). Despite some research to understand their experiences, it is not nearly enough to move the needle in terms of collective cognizance about the gravity of their experiences and issues. Furthermore, research surrounding this phenomenon in aviation has been limited across all sectors. There are additional barriers that have notably hindered the advancement of Black Americans in aviation, which can be seen in both aviation higher education and the aviation industry itself. The most common and prominent of these barriers consist of lackluster peer support, financial constraints (e.g., high flight training costs), and social isolation (i.e., lack of belonging or community) (Murillo, 2020; Molloy, 2019).

There is a lack of recent research explicating a Black American student’s experience of effectively integrating within the academic and/or social aviation collegiate environment and how integration impacts their academic performance. The research that does exist explores the lived experiences of underrepresented minorities (as a whole), women in aviation, gender implications, or practices within aviation maintenance facilities. There have been a few dissertations that delve into the experiences of minorities or underrepresented groups in aviation, but only one of them utilized a phenomenological approach, and none of them focalized the experiences of Black American students exclusively, which is where this study can add to the extant literature. Furthermore, there is a tendency for aviation-related research to only be concerned with collegiate flight programs rather than collegiate aviation programs as a whole (Molloy, 2019; Kim & Albelo, 2020; Gagliardo, 2020; Murillo, 2020).

This research will build upon the existing literature and expand the experience of Black American students enrolled in a four-year aviation program. Specifically, this research seeks to explore the academic and social experiences of Black American collegiate aviation students to ascertain and understand barriers or issues aiding in their attrition within collegiate aviation programs. These experiences may have cross-cultural implications for other racial and gender minority students, underscoring the salience of the literature contribution.

Methodology

The methodological approach used for this study was phenomenological in nature. Existential phenomenology is an approach leveraged by qualitative researchers to focus on the commonality of a lived experience within a particular demographic of people (Creswell & Poth, 2013; Tracy, 2019). Phenomenology allows the researcher to capture the essence of human experience(s) by deriving an adequate description of the phenomenon at hand to ultimately comprehend the present living moment. This approach was chosen because it has the potential to yield extensive insight into the collegiate experience(s), such as academic and social, of Black American aviation students and what factors have assisted, influenced, or (positively or negatively) impacted their collegiate aviation experience (Murillo, 2020). Research questions were addressed through interviews with ten undergraduate aviation students located in different programs in four states (Nebraska, Michigan, Ohio, and Florida), asking about experiences within their collegiate aviation program. Data was collected until theoretical saturation occurred (Murillo, 2020). This sample size is in the range of typical small phenomenological studies (Beiten, 2012; Creswell & Poth, 2013; Smith & Osborn, 2003) and appropriate given the small number of Black Americans participating in the industry (Lutte, 2021a; Silk, 2020).

Participants were recruited in two ways. One was via LinkedIn and Facebook. The researcher also identified prospective participants from an administrative report generated by a collegiate aviation administrator that included a list of students from the particular institution. All potential participants were emailed or directly messaged to establish initial contact. In the correspondence, a formal invitation was extended to them to participate.

Interviews asked two broad questions: 1) What have you experienced in terms of the phenomenon and 2) What contexts or situations have typically influenced your experiences of the phenomenon (Creswell & Poth, 2013). The interviews were conducted in two meetings. The first meeting consisted of interviews; the average duration of these interviews was 43.6 minutes, with the shortest and longest interviews ranging from 24 minutes to 59 minutes, respectively. The second meeting consisted of a brief phone call to verify and confirm the accuracy of the extracted themes. All first interviews were conducted via Zoom, recorded through the software's record functionality, transcribed by Zoom, and then checked by the researcher for errors and accuracy. Each of the second verification calls was conducted via phone. Participants were promised confidentiality, which was accomplished via the use of pseudonym codes and the removal of any identifying information to prevent instances of deductive disclosure. To further protect the anonymity of the interviewees, the academic institution where their collegiate aviation program was housed was simply referred to as 'Institution' in the findings and discussion sections.

The data and themes were extracted and derived. The researcher also took detailed notes (i.e., memos) during each interview to ensure they captured keywords, statements, emotions, and non-verbal cues exhibited by the interviewees as a means to enrich the rigor of the study. The reflective notes taken were handwritten on the printed interview protocol for each participant and later digitized into an electronic spreadsheet for quick reference.

Data Explication

The researcher explicated[1] The data was collected to extract the various themes that emerged from participant responses. The thematic analyses continued until all interviews were explicated. The unit of analysis occurred at the micro-level since the goal was to understand the participants' academic and social experience(s) as Black American collegiate aviation students. A phenomenological analysis proved beneficial in identifying essential features, relationships, ideological functions, and power relations Black American collegiate aviation students experienced within their programs between peers and faculty/staff. Such an analysis was optimal in transforming the data through interpretation, allowing for the emergent experiences and themes to be articulated clearly (Coffey & Atkinson, 1996). Simply, it rendered a unique opportunity to frame the actors (e.g., peers and faculty/staff) mentioned in the participants' testimonies to underscore the power relations and dynamics of the environment. This revealed certain issues that prevented integration, stymied academic success, and aided in attrition. This explication method was used to convey the themes as detailed in the five steps below and is commonplace within phenomenological studies.

Step 1: Bracketing and Phenomenological Reduction

The researcher wrote down all their preconceived notions, pre-existing knowledge, and personal experiences associated with the phenomenon in an Excel spreadsheet to bracket the information. This was conducted prior to the data collection

[1] The term 'data explication' is used in lieu of 'data analysis' because of the adverse connotations the term has for the phenomenological approach (Groenewald, 2004). Usage of the term 'analysis' indicates 'breaking into parts', which diminishes the phenomena or essence of the experience compiled while the term 'explication' denotes investigating a phenomena without losing paramount context (Groenewald, 2004).

process, was performed during each interview via handwritten notes on the interview protocols (and were later digitized), and was performed during the explication phase of each interview (Groenewald, 2004).

Step 2: Key Word, Phrase, or Statement Isolation

Once bracketed and reduced phenomenologically, the units of meaning were delineated. This step was done in two phases to ensure accuracy, diligence, and objectivity. The first phase consisted of replaying each interview with closed-captioning while reviewing and revising the associated transcript. During the replay, keywords, phrases, or statements made by each participant were noted. This was repeated for each interviewee until all six were completed, effectively creating a 'master list' of isolated statements that were categorized by the participant. The second phase consisted of thoroughly reviewing this master list to eliminate any redundancies (of statements) in terms of content and significance (Groenewald, 2004).

Step 3: Isolated Words, Phrases, or Statements Clustered to Formulate Themes

After the units of meaning were delineated through isolation, they were clustered to formulate themes. The list of previously reviewed isolated statements was reviewed again, but with a broader lens to aid in the clustering of these phrases based on shared meaning. Statements with similar meanings were grouped together based on topical significance, which effectively formulated the associated theme for each category. By the end of this step, there were nine themes formulated; this process aided in the development of central themes, underscoring the essence of the clusters (Groenewald, 2004).

Step 4: Theme Validation and Modification

The summation of each interview consisted of a summary that incorporated all the emergent themes from the data to render a holistic context of the experiences (Groenewald, 2004). The researcher referenced the list used in step three to assign the recently formulated themes that were appropriate to each participant. The participants were then asked during their second interview to review the extracted themes for accuracy. This provided participants with an opportunity to determine if the essence of their interview was properly captured, denoting a "validity check" of the data (Groenewald, 2004).

Step 5: General Themes Derived and Composite Summary of Phenomena Drafted

After the first four steps were completed, the general themes for all the interviews were derived, and a composite summary of the phenomenon was drafted. This summary was included in the findings section and reiterated more laconically in the conclusion. The purpose was to transform the essence of the interviewees' experiences into expressions commensurate with scientific discourse (Groenewald, 2004). The general themes were derived by examining the list of themes that were validated during step four and searching for common themes amongst each interview (Groenewald, 2004).

Validity and Trustworthiness Issues

Validity assesses the accuracy of the results, and since the knowledge gleaned from this phenomenological study cannot be measured for accuracy through statistical means, an issue is posed (Creswell & Poth, 2013; Merriam & Tisdell, 2016). To overcome this issue, the researcher ensured the research design and methodology encompassed salient concepts such as self-reflexivity, thick description (using direct quotes from participants), and multivocality via the incorporation of several participant voices. To convey trustworthiness, the researcher appeared sincere to the participants by demonstrating a sense of openness to their life experiences, which denoted a willingness to share certain aspects of one's own experience and showcased vulnerability on both sides of the 'notepad'. Sincerity, a precursor of establishing trustworthiness, was obtained via two practices: self-reflexivity and thick description. Self-reflexivity entails possessing an honest awareness of one's own identity, research approach, attitude towards, and respect for participants (Tracy, 2019). Self-reflexivity was practiced by sharing the researcher's personal motivation for the study with the participants and keeping memos of their own thoughts, especially during the data collection and explication phases of the study.

Findings

Of the 10 participants interviewed, five (50%) were male and five (50%) were female (Table 1). Participants were 22 years old, on average, with the age of those interviewed ranging between 20 and 25. Six participants resided in Michigan, one in Florida, one in Ohio, and two in Nebraska. Five participants majored in Aviation Flight (50%), three majored in Aviation Management (30%), and two double majored in Aviation Flight and Management (20%) (see Table 1). Six participants (60%) were current students pursuing a four-year collegiate aviation degree, and four participants (40%) were recent graduates from a four-year collegiate aviation program (see Table 1). Further, the education level was rather high as four participants recently graduated, and of the four, two (50%) were actively enrolled in graduate programs (RT#2 and RT#6).

Table 1
Characteristics of the Interview Sample (n=10)[2]

Pseudonym/Code	Age	Gender	Major	Education Status
RT#1	21	M	Aviation Flight	Student
RT#2	24	M	Aviation Flight & Management	Graduate*
RT#3	25	M	Aviation Flight	Student
RT#4	25	M	Aviation Management	Graduate
RT#5	21	M	Aviation Flight	Student
RT#6	23	F	Aviation Management & Flight	Graduate*
RT#7	23	F	Aviation Flight	Graduate
RT#8	21	F	Aviation Management	Student
RT#9	20	F	Aviation Management	Student
RT#10	20	F	Aviation Flight	Student

Eight themes emerged from the analysis of the interview transcripts and reflective memos. These themes are listed in Table 2 and discussed further below.

Table 2
General Theme(s) Overview

Theme	Name	CQ/RQ Addressed
1	Communities of Support	CQ, RQ1, and RQ2
2	Scholastic 'Sink or Swim'	RQ1
3	Social Isolation & Assimilation	CQ and RQ2
4	Financial Need/Support	CQ
5	Socio-Emotional Support	RQ2
6	Institutional Cultural Competency/Sensitivity	CQ
7	First Generation(al) Student Pressure(s)	CQ
8	Gender Differential - The "Only"	CQ

[2] The 'Student' designation means the participant is currently enrolled and actively pursuing an aviation-related degree from a four-year collegiate aviation program; 'graduate' means the participant graduated within the past 12-15 months from a four-year collegiate aviation program; 'graduate*' means the participant is either actively pursuing or enrolled in a graduate degree program. Due to the nomenclature varying across four-year academic institutions pertaining to collegiate aviation programs, the general terms of 'Aviation Flight' and 'Aviation Management' were utilized to standardize the responses rendered for the 'major identification' category based upon the participants explanation of their respective program of study. The participants' institution and their state of residence were excluded from the table to further protect their anonymity.

Communities of Support

The most dominant theme that emerged from participants' explication of their lived experience as Black American collegiate aviation students was *Communities of Support*. Each participant was involved in at least one Registered Student Organization (RSO) on campus. Two participants mentioned the RSO they were involved in was not minority-serving (i.e., non-MSO). The remaining eight participants noted that the RSOs they were involved in were minority-serving (MSOs). Of significance was the MSO in which seven of these participants were involved, which was the Organization of Black Aerospace Professionals (OBAP). One student also participated in Women in Aviation. Thus, eight participants mentioned being involved in an aviation-centric organization.

Participants explained the profound impact being involved in RSOs or MSOs made on their undergraduate experience, especially when contrasting their initial social and academic experiences (i.e., freshmen year) to their contemporary social and academic experiences (i.e., senior or current year). Some participants were unaware of student organizations earlier on at their respective institutions, only learning about and joining them during their years as upperclassmen, which they regretted joining so late in their collegiate careers. The MSOs, which are RSOs tailored to minority students, were described by the participants as having a significant impact on their experience as Black American collegiate aviation students. Participants asserted joining these MSOs, specifically OBAP, benefited them significantly with respect to (effectively) integrating academically and socially within the collegiate environment. One participant reported: "Being a part of OBAP was just comforting; being around people that know exactly what you're going through and the things that you can't always put into words, but because they experienced that same thing you [have, they] just have an [innate] understanding" (RT#2). Another participant also reported:

> The only thing that has been disappointing is just not having people like me, not a lot of people like me in the aviation community who look like me. And that's why you see like a kind of connection with people like [name excluded by the researcher for confidentiality purposes] and OBAP, and making sure we look out for each other because, at the end of the day, we are going to look out for each other [the] best. (RT#5)

When asked about contemporary social experiences, participants sounded more excited and joyous, emphatically furnishing vivid memories of fun experiences. Many explicated they had a small friend group they could rely on for anything they needed personally, professionally, or academically. The foundation of most of their friendships was constructed through RSO or MSO involvement and was fortified over the course of their undergraduate career to formulate their own sense of 'community'. One participant posited: "If you are not in any of the organizations and stuff, you really wouldn't know anything about the community." (RT#1) Another participant propounded: "Find more people who are looking for success like you are." (RT#3) A few participants reiterated the beneficence of being involved in communities of support such as RSOs or MSOs, because their involvement within these organizations, specifically OBAP, provided them with another layer of socio-emotional support from a communal perspective. Albeit beneficial, some participants were not fortunate enough to have access to certain RSOs or MSOs, so their access to communal socio-emotional support was rather limited. One participant, when asked to describe the communal support within their collegiate aviation program, stated:

> The main organizations they put emphasis on at the school are predominately white organizations; the minority organizations that are either created or are trying to start a chapter, we don't get the [same] support from the staff or from the school as the other organizations. (RT#6)

Participants noted some of their closest friends, best experiences, and treasured memories were made possible because of their involvement in OBAP, which was a pivotal community of support for them. This was accomplished through participant attendance at chapter events and national conferences, providing opportune platforms for peer bonding, student/faculty interaction, and networking with industry professionals. While discussing her involvement in OBAP and reflecting upon past events, one participant stated, "It's just a really good journey just being in OBAP, and I'm definitely proud to be in OBAP." (RT#9) Such a positive sentiment was prevalent in other participants' testimonies, but one participant credited the financial support that was made available for him to attend various events. When referencing OBAP, one participant stated, "Our former President went to like two or three conferences, and they got Financial Aid through the Dean's office every time." (RT#2) When asked what advice they would render to newer or younger collegiate aviation students, many responded with, "Join a RSO," adducing the (positive) impact and beneficence of communities of support, specifically RSOs and MSOs with especial emphasis on entities like OBAP, had on their respective collegiate experience(s).

Scholastic 'Sink or Swim'

Participants noted they either had a great first year or a rough start within the first year of their collegiate aviation program with respect to academics; there seemed to be no in-between. Four participants explicitly stated they entered their program with relative ease and excelled academically, while the remaining six either stated they struggled or alluded to the fact they underperformed scholastically. A few participants expressed they had been excellent students in high school, with some taking advanced courses (e.g., AP or IB), which they felt helped prepare them for the rigor of collegiate coursework. Despite being high-achieving scholars, most found the aviation coursework to be challenging, but the workload was manageable. When asked about their initial academic experience, one participant described: "Everyone came from some part of aviation, and they had that 'step in'. I never had that step in, so private pilot education, academically, was really hard for me." (RT#6) When asked to contrast their initial academic experience to their contemporary experience, the participants expressed their senior year was much more difficult, but due to natural maturation and progression, they gained more perspective and knowledge, thereby making the rigor easier to handle.

When discussing strategies or techniques to overcome certain academic challenges, one participant sounded very distressed and somewhat disappointed when preparing to share about a time they asked a female professor in the program for assistance. The participant stated, “She helped me out because I changed myself to cater to what she wanted at the time, and I did that for four years…to get what I needed…so I could succeed.” (RT#6) This parallels and accentuates the experience of another participant who (when discussing program faculty/staff) stated: “I feel like it doesn’t always feel like they [the faculty and staff] always care 100% whether we succeed or fail.” (RT#5)

The underpinnings of the scholastic experience(s) of all the participants had one thing in common: they each had to learn what “worked” for them to avoid failure. This is clearly encapsulated by a participant who explained: “I’m personally not a person that can sit down for multiple hours at a time and study. It’s very difficult for me, and at a certain point, I don’t retain information… and the biggest thing was realizing that I need to study for an hour and take a 30-minute break and keep repeating that…and that was the biggest thing I found helped me out freshmen year; figuring out my study habits, how to study, and what type of studying works best.” (RT#5)

Social Isolation and Assimilation

Several participants described their initial social experience(s) in a negative light using words such as, “alone” and “lost”, because they did not know anyone. Put eloquently, one participant stated, “I felt out of the loop.” (RT#4). Some entered college knowing they were rather introverted and sought to change that in college, prompting them to take a more active role in socializing with others and, in some cases, to no avail. Most participants found their freshmen year to be the roughest of their undergraduate career in terms of social experience because they had difficulty integrating into the social environment despite meeting and/or bonding with other aviation students. As such, they spent the first year somewhat socially isolated; those who were not isolated were forced to assimilate into groups they did not necessarily relate to racially, ethnically, or culturally. This was eloquently vocalized by one participant who noted:

> There are other girls to talk to in the program besides the instructors. [There were] not a whole lot of other people [females specifically, in the program] besides the guys, and so you just kind of become one of the guys and assimilate, and that’s kind of what you gotta do to survive, really. (RT#10)

One participant explained they joined a predominately white (social) fraternity just to be somewhat connected socially, even though they were rather inactive with said organization. Assimilation in the academic environment, especially within collegiate aviation programs, was a dominant trend in the participants’ responses. This is supported by one participant who expressed:

> I felt as though I always had to put on this kind of front or persona to make them comfortable, or to make my friends comfortable, or my professors comfortable. I mean comfortable in the way of, which honestly sounds bad, but like de-black myself; like take my vernacular [away], take away the way I say things or express myself. I just felt like I had to fit the mold of White men. (RT#6)

When asked probing questions to describe the social climate of their collegiate aviation program in terms of students and leadership, the same participant stated, “It was inclusive, but I think inclusivity always hits a point when there are predominantly White men and so little minorities.” (RT#6) Of significance, the same participant alluded to instances of imposter syndrome during a line of probing questions regarding this topic of social isolation and assimilation. This notion of imposter syndrome is evident in the first quote included in this paragraph. In this quote, the participants mentioned they had to “de-black” themselves in terms of vernacular, actions and behaviors, and identity to make their friends or professors comfortable. The “imposter” presented to their friends or professors to enhance the comfortability of these individuals was a necessary façade, as posited by RT#6, to increase the likelihood of their academic success, social integration, and opportunities within the program.

During one interview, a participant framed their initial social experience as positive, which turned out to be a double-edged sword. The participant noted:

> I would say supportive, but supportive in the way of I was the only Black female in my program. So it was support because I was the only Black female in the program and I was the person that you were going to put on the institution page (i.e., website); I was the person you were going to put in all the camera film, and anything that had to do with diversity or something - that’s who I was. (RT#6)

Financial Need/Support

The need for financial support or inability to acquire it was mentioned in each interview, with the exception of one. Those majoring in Aviation Flight and yearning to become professional pilots richly described the financial hardship associated with the major. The tone surrounding the conversations pertaining to this theme was one of negativity and disappointment; the sheer exhaustion of carrying around this “financial burden” was draped over the participants’ faces and nearly tangible. Several participants described their struggles of having to work one, two, or even three jobs to afford flight training costs on top of living expenses, tuition, and other necessities whilst being full-time students. When asked why one participant chose his particular collegiate aviation program over another, he responded with, “They gave me financial aid and scholarships.” (RT#2). When asked a follow-up question about a different program that was brought up during the interview, he replied with,

> The institution [name of the program removed by the researcher for confidentiality purposes] was out of the question. The out-of-state tuition was

> astronomical before applying flight fees. Tuition and out-of-state fees would have been in the ballpark of $60k, double that for aviation fees. (RT#2)

One participant expressed discontent with their program, comprising a very frustrating undertone that was palpable for the vast majority of the interview. When asked what his major was, the participant explained that an older aviation flight student briefly outlined the logistics of the aviation flight program. The participant added:

> Once he told me the prices, you know, I guess, that sparked something in me that said wow, I may not be able to afford this nor can my parents so I should probably switch my major. I wanted to switch my major to something else, but then I found out that the aviation business was a thing…then that's what put me on that path. (RT#4)

This frustration was compounded by the sense of defeat he experienced when he realized he was likely going to have to change his major from Aviation Flight to Aviation Management or something entirely different because he was unable to secure the funding necessary. He expressed his frustration and discontent, which stemmed from the severe lack of direction and guidance given to him as a freshman. The participant noted: "So, my first year, I had a conundrum. I didn't know like if I should start like taking out loans for flight or, you know, pursue just the management side, and I was just kind of stuck my first year." (RT#4)

For another participant, the availability of financial support dictated their academic course load and was the primary factor in deciding whether or not they could pursue an Aviation Flight major at their institution. The participant stated,

> Academically, it just comes down to finance because I have never been on a scholarship, and once again, I am not on a scholarship. It's just pretty much me trying to finance the whole thing, trying to figure out how I am going to pay for this and pay for that. I think, more [than] likely, it will be difficult as I keep going on towards the future trying to get my ratings because that is the expensive part. (RT#3)

Socio-Emotional Support

The notion of having support or people you can depend on, especially when times get tough, was a common undertone within each interview. The primary sources of socio-emotional support the participants' received were from their parents, relatives, and their friends. Several participants described how they would often lean on their family or their friends depending upon the type of support needed at the time. One participant expressed feelings of relief when discussing the salience of his friends and the pivotal role their support played in his academic progression and performance. When asked about what advice he would provide to newer or younger collegiate aviation students, he noted,

> I would say that's another big thing - find people who are driven, who are as passionate about aviation as you are because I guarantee you, at the end of the day, how passionate they are going to seep into you. (RT#5)

Only three participants mentioned there was someone within the aviation faculty/staff they could go to for support or guidance. Of significance, one participant mentioned there was a Black American woman who worked within their respective program, which provided support and was an ally. This particular staff member went above and beyond her duties to speak up on behalf of this particular participant, advocated for other students (in potentially adverse situations), fed them, and provided them with various resources. The support was so profound that the same participant stated, "She's probably the number one reason why I didn't leave the program, to begin with." (RT#8). Such a statement underscores the impact this one staff member had on the participant and likely others, which also emphasizes the importance of socio-emotional support in the collegiate environment as well as active representation in underrepresented spaces (e.g., higher education and aviation). Others in the sample were not as fortunate, which seemed to be more commonplace based on the responses rendered in the interviews. During an interview, when discussing collegiate aviation program faculty/staff, one participant appeared saddened based on his body language and facial expressions while describing his interactions with his program's faculty/staff. While recounting a specific conversation with the program's director and in a melancholy tone, he added, "…You know like what else is out there like/ what can I use with this degree, you know. There is no real direction, there's no encouragement to be able to find anything…" (RT#4).

Several participants spoke about the importance of socializing, specifically networking, and its salience within the aviation industry. This concept of networking was discussed in contexts internal and external to the classroom as two participants recommended newer or younger aviation students develop relationships with their professors and become comfortable with speaking to industry professionals, respectively. There was also a strong emphasis placed on being smart and conscientious with one's social media since inappropriate content can be a potential career-ender if discovered by recruiters. The overarching consensus amongst the participants was that making connections and having individuals provide socio-emotional support was necessary to navigate the social and academic environments within their program and, ultimately, the aviation industry. When asked what other recommendations or insight participants had for newer aviation students, one participant responded with: "Get a good circle of people in the program." (RT#10) Such a simple piece of advice was a cornerstone in her success in networking within the industry and, more importantly, navigating the nuanced social and academic structures of the academy. Further, this advice coincides with a statement made by RT#9, who stated:

> I would definitely say the first thing to do is find an RSO you think suits you. Because we have so many aviation RSOs on campus, [it] definitely makes it a lot easier to find people with the same interests as you and the same goals.

By surrounding oneself with like-minded individuals that would be a part of a RSO, one can extend their personal and professional networks, thereby expanding their access to socio-emotional support and enhancing their potential to gain knowledge about certain social events or access to academic resources they might not have obtained otherwise. This underscores the gravity of the participants' recommendation(s) and warrants the serious tone they possessed when sharing such a pivotal piece of information.

Institutional Cultural Competency/Sensitivity

Each participant described at least one instance of cultural incompetence or insensitivity exhibited by their program's faculty/staff or a fellow colleague within their program. Several participants stated they had numerous stories they could share that underscore this notion of lackluster competence but felt it unnecessary because the event had passed and it was essentially the "norm" within their respective collegiate aviation programs and, to a certain extent, the aviation industry. The overarching experience and sentiment expressed by each participant was rooted in assimilation or conformity to whatever the norm was. Some participants asserted they experienced instances of overt and covert racism or prejudice within their respective institutions. One participant explicitly stated their program (and institutional personnel) should be required to take Diversity and Inclusion training from experts to become more emotionally intelligent. When describing a specific encounter this participant had with a faculty/staff member; the participant displayed non-verbal cues of slight frustration. The participant noted the faculty/staff member stated, "I'm tired of your excuses. If aviation is not a priority, then you need to get your priorities in order." (RT#2). This same participant added that the conversation was rooted in disrespect, and they (the participant) were confused about the exchange because he had not missed a flight lesson nor incurred a tardiness.

The cultural competence and sensitivity of administrators, faculty/staff, and the student body were commonly referenced during the interviews. Several participants described situations or encounters with faculty/staff or students that could have been more positive had the aforementioned parties been more culturally competent or sensitive. While describing his social experiences at one institution, one participant stated, "The social climate and environment at [institution name removed by the researcher to protect confidentiality] was not really my speed." (RT#2). This same participant also added the social climate was one of many factors that prompted his transfer to a different institution.

The participants all sounded extremely disheartened while describing their various social encounters within their respective institutions, and some appeared (emotionally) exhausted. When asked probing questions about their social experience, specifically pertaining to their encounters with faculty/staff, one participant spoke about having to always fit the "room." They asserted:

> The issue is that the room is always 96% White male, so I'm always catering to this crowd that always excludes me. Honestly, I don't think freshmen year I noticed, but by senior year, I was exhausted, and I am tired now. (RT#6)

First-Generation(al) Students Pressure(s)

Albeit not a question asked by the researcher nor included in the interview protocol, two participants explicitly verbalized they were first-generation students. They sounded proud of this designation; one expressed they had to shoulder the weight of their parents' academic dreams and ambitions, which served as a motivator for him to do well in college. When asked why he chose to pursue aviation as a major, the participant responded with:

> I didn't come in with any surefire plan. I just knew that I wanted to be the first in the family to graduate, so I had a goal in mind, but I didn't even know what I wanted to study at the time. (RT#4)

The same question was posed to another participant, who noted:

> I looked into the professional flight program, as I said, and the courses and content were just $40k for me to fully complete it. And at that time, I had nothing. I mean, I still don't, but at the time, it was just very risky because my parents' goal was for me to be the first person in my family to get a college degree. (RT#3)

Despite these responses being provided by two different participants who possess stark backgrounds, the tone of their voices, coupled with the stiff facial expressions, emanated their seriousness and the gravity of their desire to make their respective families proud by any means necessary.

Gender Differential – The "Only"

All five female participants either explicitly stated or alluded to part of their experience in their collegiate aviation program being impacted, typically in a negative manner, due to them being the "only" female or, in many instances, the "double only." This means they were the only Black female in their classes and/or programs. When expounding upon this in several of the questions, the tone and emotion underpinning the responses was nearly palpable, as if the function of their race and gender cast a spotlight on them for the world to see. This spotlight illuminates the gender differential that often exists in collegiate aviation programs, which may go unnoticed (intentionally or unintentionally) by students and/or faculty/staff identifying as non-minority. However, for those in the minority, specifically Black female students, it cannot help but be noticed, which causes very somber and alienated feelings, as described by one participant who stated:

> In a lot of my classes, I have probably been one of the only, or one of two Black students in my class, let alone [there] probably being five girls, and I am the only Black girl;l so I guess just not feeling like I belong there (RT#8).

The above quote encapsulates the gender differential theme that was stressed amongst the female participants and adds depth to the large divide between White-males, White-women, and minorities several of the participants stated existed in their respective programs. When detailing experiences about being the "only," one participant shared something profound about how the lack of Black female representation in the industry placed additional pressure on her. She stated: "I felt like when I started [in my program] because I didn't see anyone else that looked like me, I had to carry the weight of everyone who would ever look like me that would come in there" (RT #7). This feeling was further accentuated when the same participant spoke about being the first Black female student to graduate from her program; she stated:

> Since I might be the first one…I felt like I had to keep an image and a stature that was perfect pretty much so that whatever other girl came in there, she wouldn't have to worry about how the last Black girl would impact her in a bad way. [I] wanted to make sure that I was giving them an upper hand instead of harming them in any way (RT#7).

When asked if she perceived such pressure stemming from the prominent gender differential as a barrier, she agreed unequivocally, almost with a sigh of relief, as if what she explained was understood without a long, drawn-out explanation. She responded to the follow-up question with the following statement: [It was] definitely a barrier because I didn't really know how to carry. I guess the burden of being the only one adds to the social awkwardness (RT #7). Albeit the spotlight and pressure from being the "only" emanated from the vocalization of participants' experiences, often in a negative manner, there was an instance of a silver lining stemming from the notion. For one participant, this silver lining came as a complete surprise during a volunteer shift at the local Girls in Aviation Day event, where she shared the spotlight with another person: a young Black girl whose horizons had been broadened through one interaction. While describing how her collegiate aviation program and aviation had impacted her personally, she recalled the encounter and noted:

> A mom came over to me, and she tapped me on my shoulder, and she was like, can you take a picture with my daughter… it was a little Black girl that kept staring at me…and her mom looked over at me and said she has never seen a Black female pilot before; she didn't know that was possible until she just saw you (RT #7).

Despite the many negative interactions this participant and the others elucidated upon as they fought through what sounded like emotional fatigue during the interview, this particular experience was shared with a sense of joy, excitement, and hope for the future with respect to racial and gender diversification within the industry. This supports an explicit goal shared by a participant who is “Hoping to reach more Black girls to get into aviation” (RT#9).

Discussion

The aim of this study was to ascertain the experiences of Black American collegiate aviation students as a means to explore and understand what factors have impacted their experience(s) as collegiate aviation students. The underlying rationale was to determine how these may have influenced their recruitment and retention within their aviation program and/or the aviation industry as a whole. The emergent themes from this phenomenological analysis demonstrate that the experience(s) of Black American collegiate aviation students are multifarious but share commonalities regardless of their geographic location, age, and academic institution attended. The central research question and both secondary research questions were thoroughly addressed by the eight themes that emerged from this study.

The CQ for this study sought to ascertain and understand what the experience(s) of Black American collegiate aviation students has been. An analysis of the interviews, transcripts, and reflective notes determined the overall experience of these students has been positive yet heart-wrenching and by no means easy. As Black American students pursuing education in a historically underrepresented field that has less than 3.5% of their demographic in it, students are often fighting three battles, two of which are internal. These battles consist of: 1) Combatting emotional and mental fatigue from being forced to fit within society’s standards; 2) Refusal to succumb to certain pressures and challenges endemic to the higher education environment and; 3) Struggle to maintain the balance between one’s personal, academic, and professional lives.

The first (internal) battle, which is due to external influence(s) (i.e., societal pressures), is with themselves as these students combat instances of imposter syndrome, bouts of emotional and mental fatigue as they attempt to fit the societal “norm,” and repudiate the iron wall of doubt that is bestowed upon them. This is best outlined by the emergent themes of *Social Isolation and Assimilation*, *Institutional Cultural Competency/Sensitivity*, and *Gender Differential – The “Only”*. The themes of *Social Isolation and Assimilation* and *Institutional Cultural Competency/Sensitivity* provide integral insight into the holistic collegiate aviation experience(s) of Black American students whilst underlining the mental and emotional hardship they encounter on two fronts: from their colleagues/peers and faculty/staff. If these students are experiencing inordinate difficulty integrating within their new environment because they encounter issues finding common ground with their peers and are unable to confide in program faculty/staff due to their lackluster cultural competence (via verbal and non-verbal) means, then it is not farfetched to see why many of the participants described their overall collegiate experience as “rough” or “lonely”. However, many of the participants only expressed positive sentiments about their collegiate experience as they discussed details about their junior or senior years. This means they only experienced reprieve and somewhat enjoyed their undergraduate studies towards the end of their collegiate sojourn, and this was not because of institutional or personnel improvement. The participants had to adapt to their environment, learn to make do with the friends they had, circles they were allowed to enter, and block ignorant, or in some cases discriminatory, comments made by faculty/staff. Part of this adaption process, which aided in their "survival", can be traced back to their involvement in a RSO or MSO. The positive role their organization played in these years cannot be overstated, specifically supplying them with colleagues they could rely on for advice or resources necessary to overcome certain obstacles whilst serving as a positive source of support.

The *Gender Differential – The "Only"* theme is a profound one that only intensifies the battle many Black American collegiate aviation students must endure. However, this particular battle is gender specific, impacting the Black American female students who are effectively isolated and alienated from the remainder of the aviation students. Several of the female participants asserted there is a noticeable divide between the white-male and white-female students and the minority students, implying the alienation is intentional potentially due to their race and/or gender (as Black women). Thus, based on the experiences shared by the female participants, they felt Black American women do not fit within the societal and historic standard carried within the white-male-dominated aviation industry. Further, there was an underlying perception shared by all the participants that they were looked down upon and, in some cases, ostracized for attempting to break barriers. This was explicitly connoted by two of the participants who shared feelings of not belonging in the classroom with their peers and receiving lackluster support from students, faculty, and staff at their respective institutions. The emotional and mental fatigue and, I would argue, borderline exhaustion from being a Black American in U.S. society can be overwhelming on its own, but when this is compounded by others in the academic environment where students should feel safe and accepted, how are students who represent the "only" supposed to combat the feelings of not belonging, alienation, and frustration? This is a rhetorical question, one the Black American male students that were interviewed did not have to answer nor necessarily experience, emphasizing the gender differential facet of the theme. Such a blatant perpetuation and confinement of gender inequity in social and academic spaces constitute a detour from the ideals of equality and equity, two principles upon which higher education and civil society are predicated (Parente & Martinho, 2018).

On a lighter, more positive note, the experience of being the "only" has yielded a favorable outcome for some but is not nearly enough to tip the equity scales pertaining to the female participants' collective experience(s). Specifically, one participant was the first Black American female graduate from her program, resulting in her receiving attention and unwanted remarks from students, faculty, and some community members. Although this was an amazing feat, the participant who shared this testimony was under the perception the attention she received was only given out of envy and wonderment since a Black American female student had managed to matriculate rather than being applauded for her academic merits performance. This tends to happen far more than some realize, is a disservice to the individual, and diminishes accomplishment. Due to such a distinguishing accomplishment, this same graduate inspired a young Black girl who had never met a Black female pilot before and, until the encounter, believed aviation and, specifically, becoming a pilot was not something she could do. Therefore, through passive representation, the gender differential of being the "only" helped overcome the invisibility cloak that tends to be thrust upon women socially to ultimately make strides towards breaking out of the confinement of the secondary labor market where women are often shelved (Parente & Martinho, 2018). Simply, the strength of visibility resides in its ability to empower minority youth to aspire to positions they thought not obtainable, which works to provide reprieve for those fighting mental and emotional battles while reforming societal norms to be more equitable.

The second (internal) battle is one that is nearly inevitable for many Black American collegiate aviation students, especially for those who come from low-income households and were not fortunate to have family members involved in the aviation industry. This battle primarily consists of not succumbing to the constant pressure of being a first-generation student, navigating a new space, and doing well scholastically. None of the aforementioned are easy feats individually and may seem insurmountable as a collective. The pressure of being a student is already momentous for the layperson; when factoring in additional responsibilities such as having to work or handle other external obligations while being a full-time student who happens to be first-generation, it is nearly crushing. This narrative is far too common for Black American students, and the sentiments conveyed by two participants accentuate this notion, which is encompassed by the theme of *First-Generation(al) Student Pressure(s)*. Carrying the dreams, goals, and ambitions of one's parents, as well as their entire family, places an inexplicable amount of pressure on first-generation students that is almost palpable. Navigating the higher education environment can prove challenging for even seasoned students, making routine ventures to find the library or the cafeteria appear daunting for new students, with special emphasis on those who may have never been on a college campus. This is only exacerbated by the fact that they cannot seek answers to certain questions from those they may trust the most as they are first-generation, forcing them to rely on fellow colleagues who may be just as confused as them or (some) faculty/staff that may be reluctant to assist for various reasons.

The third battle Black American collegiate aviation students fight is an outward one that is seemingly perennial. The bout consists of Black American students fighting to maintain the delicate balance that is required to work their jobs so they can satisfy their economic and social needs and earn good grades to maintain their scholastic commitments (e.g., contingent scholarships). This is not a fair fight for most students, but for Black American collegiate aviation students, specifically those majoring in Aviation Flight, the odds are almost never in their favor. This stems from the immense cost of flight training on top of traditional higher education costs (e.g., tuition, books, fees, etc.)

The emergent theme of *Financial Need/Support* encapsulates the sobering figures detailed by the participants to describe the disparate impact flight training imposes on those yearning to become professional pilots. Such a financial constraint adds undue stress, lowers morale and motivation, and can cause the student to feel defeated. This was axiomatic, with one participant stating he was forced to change majors and even contemplated leaving his aviation program altogether. Despite receiving financial aid from his institution, it was still not enough to bridge the gap, which was a sentiment shared by nearly every participant. Consequently, he deferred his dreams of becoming a pilot; had he not switched his major, it would have prolonged his expected graduation date. Thus, he made the switch because he literally could not afford to remain in the flight major or become bogged down in despair from the switch, or else it would impair other facets of his life. At its core, financial stability or fiscal availability is a large predictor of completion for Black American collegiate aviation students, specifically those wanting to become professional pilots, which is adduced through research by NRC (1997) and Murillo (2020). These interview findings highlighted the notion that those with access to funding tended to have a better overall collegiate experience than those who did not. For those who did not have the same access, the feelings of disappointment and defeat permeated through each question and notably impacted their perception of collegiate aviation.

Involvement in a community of support (e.g., an RSO or MSO), specifically OBAP, positively impacts the collegiate experience. Specifically, the ability to make friends, socialize regularly, and enjoy one's undergraduate career was significantly improved. As such, participants expressed they felt more inclined to engage in and create study groups or seek institutional resources (e.g., attend the writing center or math tutoring/lab), both of which affected their academic performance. Additionally, several participants noted many of their most treasured friendships arose from their involvement in RSOs or MSOs. These friendships and involvement in something bigger than themselves provided a renewed sense of self, higher purpose, and a sense of community they had not experienced in their first, second, or even third year of college. For some, the involvement in OBAP or an akin RSO was the sole difference maker in changing their collegiate experience from negative or adverse to positive and empowering. The participants' involvement in an RSO or MSO, such as OBAP not only impacted their social experience but also improved their academic experience. This stemmed from some forming study groups or hosting academic activities, in which many of their friends attended or helped establish. Thus, based on the testimony of the participants, their ability to integrate within the academic and social environments was positively influenced through their involvement in RSOs or MSOs with a special emphasis on OBAP, and they recommended future students get involved in something similar as soon as possible. Such a positive experience and recommendation helps to answer the CQ and both RQs directly, thereby underscoring the *Communities of Support* theme.

The *Scholastic Sink or Swim* theme also directly addresses RQ1. Albeit some participants had a positive academic experience due to their involvement in MSOs like OBAP, a couple of the participants were not fortunate to have such an organization on their campus to help establish friends or access academic support. Generally, the participants either had a great academic experience or were "muddled" through, especially during their first two years, for various reasons. Prominent reasons these participants struggled academically consisted of coursework challenges, workload issues, difficulty navigating the academic space, and/or being confused about whom to go to for help or where to go for specific resources. These reasons were commonalities amongst the testimony of the participants and can pose significant retention issues if not resolved promptly (Jama et al., 2009). Further, these issues may help explain why participation rates of racial minorities in higher education and collegiate aviation programs have continued to be low, as posited by Bowen (1990), Ison et al. (2016), and Ison (2018).

The *Socio-Emotional Support* alongside the *Social Isolation and assimilation theme, which was discussed earlier in this section, directly addresses* RQ2. Every participant described how their initial and even contemporary social experiences were lonely and rough because they hardly knew anyone. Several of the participants were the only Black American aviation students in their respective programs, and it was not until they progressed in the program that they met other students they could relate to racially, ethnically, or culturally. Without having a community or friend group to source socio-emotional support from in immediacy, some participants relied on stoic emotional and moral support from their parents or family members. They were able to decompress and find solace by speaking to and hearing the voices of those they were most familiar with. Despite the family members not being knowledgeable about aviation, the fact the student could communicate with someone familiar with them and essentially latch onto was enough to help them overcome the adversity at the time.

This “lifeline” can be best summated by the adage, “It takes a village to raise a child”, yet some of the participants indicated they did not have a village to lean on. In instances such as this, when situations became bleak, they were forced to rely on themselves and the few individuals they had available to push through. This is not uncommon as a few of the participants indirectly alluded to “struggling in silence” while putting on a façade for those external to the issues because they were too mentally, emotionally, or physically exhausted to share or felt it asinine, causing those listening to not understand anyway. Such feelings are unhealthy to harbor and add to the crushing pressure many already feel, further underscoring the salience of socio-emotional support for students, especially those who are Black American. In the Black American community, seeking help for mental or emotional health has been deemed taboo and can be a contentious topic for families. This communal and illogical societal maxim is subsiding slowly and is more tantamount than ever, given the implications of the pandemic, race relations within U.S. society, and the heightening of mental health awareness within aviation.

The findings from this study not only add to the existing literature in several ways but also fill the gaps that exist, specifically by exploring what it means to be a Black American student in a collegiate aviation program via understanding their lived experience(s) and illuminating factors that impact the academic and social success of these students. Such an illumination adds a new duality to previous research that only examined the experiences of underrepresented minorities (as a collective) in collegiate aviation flight programs (Molloy, 2019). In contrast, this study specifically explored the experiences of Black American collegiate aviation students enrolled in both Aviation

Flight and Management programs, underlining the duality. Further, much of the research examining this phenomenon exists in the forms of theses and dissertations, with peer-reviewed works being scant. As such, this phenomenological study not only bolsters the quality and quantity of the existing literature examining the experiences of the designated demographic but also explores the underpinnings of the lackluster racial diversity issue plaguing aviation programs and STEM-related majors. This was accomplished through the ten emergent themes derived from the study, which render critical insight into what constitutes, impacts, and influences the academic and social experience(s) of Black American collegiate aviation students.

The eight themes that emerged from the study help provide a holistic overview of the various factors that contribute to the academic and social success of racial minorities, specifically male and female Black American collegiate aviation students. The themes of *Communities of Support and Socio-Emotional Support all encompass factors participants* noted positively impacted their academic success and/or shaped their social experience(s) as collegiate aviation students. This is paramount because it aligns with a prior study that explored a similar phenomenon but focused on gender equality and minority women (Kim & Albelo, 2020). This study adds to the existing literature because it elucidated (success) factors pertinent for Black American students identifying as male or female. The elucidation of these factors (as encompassed by these three themes) is important because they are integral for the effective academic acclimation and social integration of Black American students within the academe, which has been suggested to increase their retention (and, subsequently, matriculation) within higher education (O'Keeffe, 2013; Jama et al., 2009).

Future Research

The fact that all the programs the participants included in this study belonged to were exclusively located at Predominately White Institutions (PWIs) is a limitation. It can be speculated the experience(s) of students attending a PWI may be drastically different than those attending a comparable Historically Black College or University (HBCU), Minority Serving Institution (MSI), or Tribal College and University (TCU) for a variety of reasons. The most prominent of these reasons may include differences in racial representation on-campus in terms of faculty/staff and students, funding and tuition costs, student resource availability and accessibility, and institutional culture. Therefore, future studies should explore the experience(s) of collegiate aviation students identifying as Black Americans who attend institutions not classified as PWIs. This means institutions classified as HBCUs, MSIs, and/or TCUs should be examined.

Recommendations

Collegiate Aviation Administrators:

1. Diversity and Inclusion (DNI) and Cultural Competency/Sensitivity training are required to be completed by all faculty/staff employed within or associated with (e.g., Flight Training Service Providers) the academic institution. This can be facilitated through the

current institution's system that already mandates employees complete sexual awareness/assault training at the beginning of the academic year.

2. Make more concerted efforts when hiring faculty/staff internal and external to the collegiate aviation program that identifies as racial and/or gender minorities to increase representation.

3. Provide financial and administrative support for racial minority students attempting to establish RSOs or MSOs within an academic institution. This is pivotal in not only fostering a sense of belonging for many students who feel alienated but also serving as an excellent recruitment and retention tool for the aviation program and institution itself.

4. Consider restructuring the financial aid packages offered by the academic institution for students majoring in Aviation Flight who identify as a racial and/or gender minority, are first-generation, and classify as low-income. Ideally, this package should provide them with enough funding to be able to complete the training necessary to earn their private pilot certificate since this is usually the most expensive and time-consuming certificate to attain.

Aviation Industry Leaders:

1. Continue concerted efforts to create pathway programs and partnerships with collegiate aviation programs, especially those located at HBCUs and PWIs.

2. Consider partnering with MSOs, such as OBAP, to expand industry outreach and exposure to areas that lack an aviation presence within the community, and visit middle or high schools located in lower socioeconomic areas to furnish exposure to students who tend to possess limited access to prominent aviation entities.

3. Create additional funding packages and scholarship opportunities aimed specifically at those who do not possess a private pilot certificate, are first-generation students, and identify as a racial and/or gender minority. There are numerous scholarships available offered by nonprofits, of which some are funded by commercial entities, but this number is limited and could be bolstered to help incentivize students to enter, advance, and remain within aviation.

Conclusion

This study sought to build upon the existing literature and expand upon what it means to be a Black American student enrolled in a four-year aviation program. Due to the lack of understanding about these experience(s) in previous studies, this research aimed to address the gap by exploring their academic and social experiences and understanding barriers or issues aiding in the attrition of Black American students within collegiate aviation programs. A student's involvement in an RSO or MSO (e.g., OBAP) appeared to be a notable difference-maker in one's experience with respect to severity. Simply, those involved in an organization tended to experience a smoother, more expeditious acclimation academically and socially integration into their collegiate program than those that did not. Consequently, they experienced more frequent instances of positive academic and social experiences, impacting their overall perception of college. Subsequently, their mentality also improved whether they noticed it at the time or not, implying their involvement in the organization served as a positive influence on their retention within the program. Due to the many positive academic and social experiences they possessed, the vast majority of the participants recommended incoming Black American collegiate aviation students join an organization as well, denoting its utility as a recruitment and retention tool. It should also be noted that this study highlighted how gender impacted one’s experience. Specifically, being a Black American female yielded a different experience than being a Black American male. This study also underscored the importance of socio-emotional support for these students, which can help reduce instances of social isolation and assimilation many of the participants described during their first two years of college. This is important to consider because a student’s freshmen year is often a good indicator of their academic progress and retention within higher education, so if they are unable to garner the academic or social support needed within that first year, then they may be more susceptible to attrition.

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APPENDIX - Interview Protocol

Question Overview/Structure:

- 1-3: Rapport establishment
- 4-8: Academic and social experiences
- 9-10: Sense of belonging/community
- 11-12: Barriers
- 13-15: Catch-All

1. **Tell me about yourself:**
    - **a.** Where were you born and raised?
    - **b.** What four-year institution did you attend?
    - **c.** What is/was your major (Aviation Flight, Management, or other)?
2. How did you get involved in aviation?
3. **Why did you decide to pursue aviation as a major in higher education?**
4. **How would you describe your initial social experience (i.e., the first year) within your collegiate aviation program?**
5. **How does this experience compare or contrast with your contemporary experiences within the program?**
6. **How would you describe your initial academic experience (i.e., the first year) within your collegiate aviation program?**
7. **How does this experience compare or contrast with your contemporary experiences within the program?**
8. **How did you go about integrating socially and/or acclimating academically into the collegiate environment, specifically within your aviation program?**
9. How has being a student of this program impacted you personally, professionally, and/or academically?
10. How would you describe the collegiate aviation community (on-campus) in terms of students, leadership, and events/activities?
11. **What barriers, if any, have you experienced as a Black collegiate aviation student? Can you provide an example of one of these barriers?**
12. **What has assisted you in overcoming said barriers?**
13. **How do you think your program could improve based on your experience(s)?**
14. What recommendations do you have for newer/younger aviation students to be successful in your collegiate aviation program and the aviation industry, in general?
15. **Is there anything else you would like to share that you feel pertinent to this interview regarding your collegiate aviation experience(s)?**

***Note: Bolded questions are top priority**

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Student Mental Health Crisis: Perceptions of Collegiate Flight Students

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Student mental health is worsening. On top of the mental health stressors that come with being a college student, collegiate flight students are introduced to an entirely separate set of situations that can trigger mental health disorders. Because of these added stressors, poor mental health and suicide rates among flight students are becoming a more prominent issue today. The fear of being grounded by the FAA or having a medical certificate revoked contributes to the withholding of mental health symptoms of pilots. Not only does this create a concern for suicide and self-harm, but it also creates a safety concern regarding a pilot's decision-making skills, putting themselves and others at risk. This study highlights collegiate flight students' perceptions associated with mental health. The results of this survey are examined in the context of three research questions, which guided the researcher's conclusions regarding collegiate flight student mental health. In summary, four significant findings emerged from the study: (1) mental health, including depression, anxiety, and/or stress, is a prominent issue among collegiate flight students; (2) being observed or evaluated by others, financial issues (flight costs), and FAA check rides/practical tests are a main source of depression, anxiety, and/or stress in collegiate flight students (3) collegiate flight students find underreporting of mental health concerns to be more beneficial to their career than seeking treatment, (4) students believe that change is necessary and beneficial, as it relates to the current FAA medical certification process.

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Introduction

Student mental health is worsening. In 2020, a national survey of college students found that 39% will experience depression. One in three reported having had anxiety disorder, and one in seven (13%) said they had thought about suicide in the past year (Healthy Minds Network, 2020). In addition to the mental health stressors that come with being a college student, collegiate flight students are introduced to an entirely separate set of situations that can trigger mental health disorders. Previous research has found the most stressful factor of flight training to be Federal Aviation Administration (FAA) practical tests, followed by financial concerns, written exams, flight course workload, check ride scheduling, and time management (Robertson & Ruiz, 2010). In general, college can be a defying time for eighteen- and nineteen-year-old students, but it can become more so when these students are experiencing mental health issues (Center of Collegiate Mental Health, 2018). Because of added stressors associated with flight training, poor mental health, and suicide rates among collegiate flight students are becoming a more prominent issue today.

Statement of the Problem

In October 2021, a 19-year-old student pilot at the University of North Dakota committed suicide in a plane crash. After his death, the pilot's family found letters he had written to them, revealing that he had been suffering from depression and feared this would cost him a pilot's license. He wrote to his parents that *life without flying was not worth living* (Wurzer & Gordon, 2022). More recently, in January 2024, a 23-year-old flight school student in Addison, Texas, stole a Cessna 172 from his flight school and deliberately crashed the plane into a field 80 minutes later (Hawkins, 2024). While talking with air traffic controllers, the flight student said he was going to cease communications:

> *I'm climbing up through the clouds and then just gonna head out outside of everything. And right about now, you'll realize I'm not going to listen to y'all's instructions. And I'm just heading to east Texas … I'm going to pull the Comm 1 circuit breaker and Comm 2 circuit breaker, soon as I unkey the mic."*

The pilot's death was ruled a suicide (NBCDFW, 2024). Authorities said the student left a suicide note at a residence in Dallas (Godlewski, 2024)

Even the slightest suspicion of a mental health issue can ground a pilot, and if a diagnosis is made where the FAA believes the pilot is unable to sustain flight requirements, the pilot's certificate may be temporarily or permanently revoked by the FAA (Morse & Bor, 2006). This fear of being grounded by the FAA or having a medical certificate revoked contributes to the withholding of mental health concerns of pilots. Therefore, many pilots feel as though they are unable to report their anxiety or depression and seek help without the consequences of losing flight privileges, threatening their careers. Not only does this create a concern for self-harm, but it also creates a safety concern regarding a student pilot's decision-making skills in the cockpit, putting themselves and others at risk.

Purpose of the Study

The purpose of this study was to solicit flight students' perceptions regarding mental health concerns and added stressors associated with collegiate flight training.

Research Questions

The following research questions were addressed by surveying collegiate aviation students' perceptions regarding mental health:

RQ1: Is there a stigma surrounding mental health within the aviation industry, specifically among collegiate flight students?
RQ2: Does collegiate flight training create additional stressors that can exacerbate student mental health?
RQ3: Do collegiate flight students face external pressures that deter them from reporting poor mental health?

Significance of the Study

Mental health has become a more prominent issue within the collegiate aviation environment as student pilots are challenged with a separate set of situations that can trigger mental health problems. Depression, anxiety, and/or stress among collegiate flight students have resulted in a noticeably increasing rate of suicides and thoughts of self-harm in the past few years.

This research study is significant because it provides insight into collegiate flight students' perceptions regarding mental health, as well as providing answers and information regarding the lack of reporting poor mental health among collegiate flight students due to the fear of being grounded or other repercussions that may follow. The answers and information in this study help bring more attention to the mental health of student pilots and can be useful to the collegiate community, as well as the aviation industry, in creating solutions and support systems for pilots struggling with mental health disorders.

Limitations and Assumptions

For this study, the following limitations and assumptions existed:

1. This study was limited based on the voluntary participation of collegiate flight students asked to complete the survey and submit it to the researcher.
2. This study was limited to flight students currently enrolled in a four-year collegiate flight program offering a comprehensive aviation curriculum and awarding a bachelor's degree in professional flight.
3. It is assumed that collegiate flight students answered the survey questions honestly to the best of their knowledge.

Literature Review

Pilot Suicides and Suicidal Thoughts

For decades, commercial airline travel has grown progressively safer. However, one cause of death has stubbornly persisted: airline pilots who intentionally crash in murder-suicides (Levin, 2022). While suicide by airplane is not a common occurrence, it does happen, and suicide is still a very prominent issue within the aviation community. In August 2018, the apparent suicide of a Horizon Air employee on an unauthorized flight with no passengers marked a rare crash for an airliner (Jansen, 2018). With no passengers aboard, this incident was treated like a general aviation accident, where a single pilot crashes a private plane alone. In October 2000, while practicing a series of landings on his Piper airplane, a pilot in South Dakota asked the air traffic controller to tell his family and friends that he loved them. Then, the pilot made a low runway approach, pulled his airplane in a vertical climb, pushed over into a dive, and crashed in the middle of the runway (Siegel, 2005).

Unfortunately, there are more prominent examples of airline-pilot suicides. Most notably, on March 24, 2015, a Germanwings commercial aircraft crashed into the French Alps, killing 150 passengers and crew members. The co-pilot of the flight committed suicide due to a history of psychological issues, including depression. Within the past 25 years, other notable instances of suicide by airplane have occurred, including the crash of EgyptAir Flight 990 in 1999, killing 217 people, and the crash of SilkAir Flight 185 in 1997, killing 104 people (Politano & Walton, 2015). The reason for the disappearance of Malaysia Airlines Flight 370 in March 2014, with 239 people on board, remains a mystery (Jansen, 2018).

As of 2020, pilot murder suicides like these, where it has been concluded through post-accident analysis and investigation that the pilot deliberately crashed a commercial aircraft, had occurred in six instances over the span of 30 years (Vuorio & Bor, 2020). A research study utilizing the National Transportation Safety Board’s (NTSB) accident database system found that, of 74,573 entries between 1982 and 2014, 45 records were identified by suicide code, with an additional 30 records that were judged to be suicide based on suicidal notes and coroner findings (Politano & Walton, 2015). However, while these studies show the rate of actual airplane-assisted suicides, they do not measure the prevalence of suicidal thoughts among pilots.

A study conducted in 2016 found that 4% of airline pilots had reported having thoughts of being better off dead or self-harming within the previous two weeks of participating in the study. Furthermore, within this study group, 13% of pilots met the criteria for depression, and 14% of pilots who stated they had worked within the past seven days of participating in the study had met the criteria for depression (Scutti, 2016). Key findings of the study prove that hundreds of airline pilots are managing depression and suicidal thoughts without the possibility of treatment due to the fear of negative career impacts (Wu et al., 2016).

Mental Health and Collegiate Aviation

In 2021, the American College Health Association released its National College Health Assessment and found that just over 70% of college students report moderate to serious psychological distress (American College Health Association, 2021). In another study, Lipson et al. (2022) found that in 2020-2021, approximately 60% of college students met criteria for one or more mental health problems. The researchers also determined that the mental health of U.S. college students has consistently worsened from 2013-2021, with a 135% increase in depression and a 110% increase in anxiety during these eight years of analyzed data. And the number of college students who met the criteria for one or more mental health problems in 2021 had doubled from 2013 (Colarossi, 2022).

According to a 2022 Student Voice study regarding college student health and wellness, more than half of the 3,000 participating college students stated they experienced chronic stress, which is associated with worse mental health (Flaherty, 2023). The findings of the study revealed that many college students see their professors as the front line of support, as more than 40% of students stated professors have a responsibility to help. Approximately 30% of the students believed it was their own responsibility, and the same percentage of students said campus counselors take responsibility (Flaherty, 2023).

A study conducted (2018) by Robertson and Ruiz surveyed 182 collegiate flight students regarding stress as a collegiate flight student. Even though collegiate flight students make up a small percentage of total U.S. college students, they have similar rates of psychological stress and mental health problems. The survey found a total of twenty-eight sources of stress, with the two most stressful factors being check rides and financial factors. Other factors that were rated as moderately stressful were written exams, flight course workload, check ride scheduling, and time management. In addition, flight students were asked whether these stressors have a positive or a negative effect on their flight performance. Approximately 20% of participating students indicated they believe the stressors have a negative effect, while 30% indicated that the effect depends on the stressor.

Psychological Evaluations and Medical Certificate Requirements

Pilots are required to meet specific medical and mental health standards for each class of FAA medical certificate (Federal Aviation Administration, 2022a). Psychiatric and psychological evaluation is required to meet these standards because mental disorders and the medications used for treatment may produce symptoms or behavior that would make an airman unsafe to perform pilot duties (Federal Aviation Administration, 2021). To obtain a first-class airman medical certificate, pilots must report any health professional visits during the previous three years and disclose all existing physical and psychological conditions and medications (Barajas et al., 2022). Additionally, pilots must show no signs of any other personality disorder, neurosis, or mental condition that may make them unable to safely perform their duties or exercise the privileges related to the medical certificate (National Archives and Records Administration, n.d.).

An Aviation Medical Examiner (AME) medically certifies pilots and is responsible for identifying any causes that call for medical certificate denial (ATP Flight School, 2022). An AME is responsible for identifying mental health conditions that affect judgment, emotional control, or mental capacity with loss of behavioral control (Nash, 2022). However, they are not responsible for conducting psychiatric and psychological evaluations. Separate evaluations and reports are required from both a qualified psychiatrist and a qualified clinical psychologist. These evaluations and reports then assist the AME with determining an airman's medical qualifications (Federal Aviation Administration, 2021).

FAA regulations prevent an AME from issuing a medical certificate to a pilot who is using antidepressants, antianxiety drugs, antipsychotics, attention deficit hyperactivity disorder medications, mood stabilizers, sedative-hypnotics, stimulants, or tranquilizers, even if they are used for reasons other than mental health (Federal Aviation Administration, 2022b). However, in 2010, the FAA approved four selective serotonin reuptake inhibitors (SSRI) to be used under an FAA Authorization of a Special Issuance (SI) or Special Consideration (SC) of a medical certificate. These FAA-approved SSRIs are (1) Prozac, (2) Zoloft, (3) Celexa, and (4) Lexapro (Barajas et al., 2022). While these four medications are effective in treating depression, no other mental health medications to address other mental health issues are approved by the FAA for pilots. So, an AME may issue an SI or SC to an applicant taking one of these four SSRIs to treat a depressive disorder if the applicant does not have symptoms or a history of suicidal ideation or the use of other psychiatric drugs in conjunction with SSRIs (Diamond, 2018).

Underreported Mental Health Issues by Pilots

Pilots suffer from anxiety and depression just as the rest of the U.S. population does. However, pilots are less likely than those in other careers to seek support and treatment (Barajas et al., 2022). However, due to FAA restrictions regarding mental health, depression, and anxiety, statistics can be difficult to measure precisely due to pilots underreporting for fear of being grounded or losing a medical certificate.

Reyne O'Shaughnessy, an airline pilot and founder of a mentoring and coaching program for pilots, understands the pressures of being a pilot and has advocated for mental health in the aviation industry for years. When asked why pilots are reluctant or afraid to seek help for mental health issues, she stated,

> None of us are eager to disclose deeply personal information. Pilots believe that being vulnerable and sharing feelings or struggles, such as anxiety, depression, and chronic stress, would be, at best, humiliating or embarrassing and, at worst, the end of their flying career (Barajas et al., 2022, para. 24).

Additionally, when asked if the FAA plays a significant role in why pilots stay quiet, O'Shaughnessy stated that FAA regulations force pilots underground (Barajas et al., 2022). Pilots are forced by FAA regulations to decide whether to seek help at the risk of being grounded.

With the fear of reporting mental health issues comes the fear of reporting medications used to treat these mental health issues. A study conducted in 2007 found underreporting of the use of antidepressants in medical examinations among a group of civilian pilots involved in fatal accidents (Sen et al., 2007). Although the FAA has approved certain medications, there are still many regulations and rules for those who disclose to an AME they are taking an SSRI. Because pilots can be grounded for at least six months once starting a new SSRI prescription, this can account for much of the underreporting of mental health medications (Bayern, 2021).

Last, a 2023 study at Western Michigan University's College of Aviation was designed to determine if flight students had a restrictive perception of the FAA rules regarding seeking mental health assistance and if flight students had a lower desire to seek out professional mental health assistance because of their perceptions regarding the FAA. The results showed that 53% of students believed the FAA regulations were restrictive, with 47% of students reporting FAA regulations had a negative effect on their desire to seek mental health assistance (Stein, 2023).

Methodology

This exploratory study identified the perceptions of collegiate flight students regarding mental health concerns and added stressors associated with flight training. The collection of data consisted of responses of collegiate flight students, using a 4-point Likert scale, to statements using an anonymous online survey.

Selection of the Research Population

The population for this study was selected by the researchers based on characteristics needed to appropriately answer the research questions, creating a purposive sampling of flight students enrolled in four-year collegiate flight programs awarding a bachelor's degree in professional pilot. Purposive sampling is a non-probability method used to obtain a sample of the population where the researcher uses their expertise to choose specific participants that will help the study meet its goals (Frost, 2023). These participants share certain characteristics that the researcher needs to answer the research questions. In other words, the researcher picks the participants *on purpose* (Nikolopoulou, 2023).

The selection of flight students for participation in the research study was determined by their enrollment status in a collegiate flight program during the 2022-2023 academic year. The selection of flight students was not discriminated against based on gender, race, religion, or ethnicity, and all students voluntarily chose to participate in this study with no compensation benefit.

The flight students remained anonymous using the following methods: (1) the research questionnaire did not ask for the participant's names, (2) the data provided by the participants could not be linked back to a particular collegiate flight program or an identifiable email account, and (3) the data submitted by the participants were anonymously coded and electronically sent to a web-based survey tool. In addition, the participants were notified in the cover letter that contributing to this research study was strictly voluntary, and they were free to withdraw their consent and participation in this study at any time.

Description of the Research Instrument

Directed by descriptive research, this study used a research instrument (survey) developed by the researchers. The primary purpose of descriptive research is to describe the characteristics, behaviors, and attributes of a particular population (Sirisilla, 2023). The researchers developed the survey to investigate the perceptions of collegiate flight students, as well as obtain demographic data and individual comments from each participant related to their perceptions regarding mental health concerns and added stressors associated with flight training.

The research survey consisted of three sections: (1) demographic information, (2) Likert scale statements, and (3) individual comments. The first section of the survey prompted demographic (personal) information characterizing each participating flight student. The personal information sought by the researcher included the participant's gender, medical certificate class, total number of flight hours, and earned flight certificates/ratings. The second section administered a series of Likert statements, requiring a strongly agree, agree, disagree, or strongly disagree response from each flight student. The list of statements was considered with the intention of gaining insight into the participating students' perceptions of mental health, including anxiety, depression, and/or stress, and additional stressors added because of flight training. The last section of the survey provided the participants an opportunity to provide their own personalized comments and observations regarding student mental health.

Reliability and Validity

The questions and statements within the survey were constructed to ensure they provided understanding of the three research questions. Each of the questions and statements within the survey were written in such a way to minimize the potential for misunderstandings within the participating student pilots.

The research survey was reviewed by several collegiate faculty members prior to being administered to the collegiate flight students. In addition, each collection of answers for every survey question or statement was statistically evaluated to ensure variation amongst answers and identify any statistical discrepancies within.

Data Collection Procedure

The researchers purposively contacted eleven collegiate flight programs offering a four-year professional pilot or similar flight degree option. Due to participants not identifying their collegiate flight program or other geographic identifiers, the distribution of the final participating educational institutions was unknown.

The survey developed for this study was distributed using Qualtrics, a web-based survey tool that allows the collection of anonymous data. The participating collegiate flight students were asked to complete the survey using a secure password-protected weblink designed to protect participants' responses. The researchers were the only people who had access to this password-protected, private, and encrypted web link.

The survey was distributed to the collegiate flight students via an email invite. The researchers sent an email to aviation faculty members employed at the collegiate flight programs. The body of the email provided (1) precursory information regarding student mental health, (2) the name, email address, and institutional affiliation of the researchers, (3) the title of the research study, (4) the purpose of the study, (5) time required to complete the survey, (6) inform the students the responses are anonymized, and participation is voluntary, and (7) an embedded link to the online survey. Subsequently, the collegiate flight programs (faculty) were asked to distribute the email to their flight students.

If the student decided to participate in the study, they were required to acknowledge a consent form. The consent form provided (1) voluntary consent information, (2) requirements to participate in the study, (3) time requirement to complete the survey, (4) information regarding the protection of privacy and confidentiality, (5) contact information for the researchers, and (6) two buttons for students to consent and decline consent to participate in the survey. All participating students were required to be at least 18 years old and a collegiate flight student. If a student did not meet these requirements or chose not to participate in the survey, they selected the button to decline consent and exited the survey.

A follow-up email was sent to the aviation faculty two weeks later. After thirty-two days, the researchers reviewed and evaluated the data from all participants, completing the data collection process in summer 2023. To ensure a more thorough and complete understanding of collegiate flight students' perceptions of mental health, including anxiety, depression, and/or stress, each question of the survey was coded into Qualtrics to require a response from the participant, ensuring that each submitted survey was completed in its entirety.

Statistical Analysis of the Data

Following the data collection, all participant information from the survey questions and statements was categorized in terms of quantitative data. The demographic data and the perceptions of the collegiate flight students were examined and explained through descriptive statistics. Descriptive statistics are used to present quantitative data concisely and meaningfully and provide a foundation for further analysis, decision-making, and communication of findings (Simplilearn, 2023). A benefit of using descriptive statistics is that it allows the researchers to effectively describe and communicate patterns that might emerge from the data. Descriptive statistics helps define and summarize data using percentages, rates, graphs, and frequency distributions (Laerd Statistics, 2018).

The open-ended question responses in the last section of the survey were exported to an Excel document, allowing the researchers to review all individual comments from the flight students and make an initial assessment of patterns and trends among answers. Combining the hard data that quantitative research provides and the soft data that qualitative analysis provides allowed the researchers to develop accurate and comprehensive conclusions (Stsiopkina, 2022). The qualitative data provided in the comments section allowed the researchers to better understand the Likert scale responses provided by the participating students and allowed the students to provide additional thoughts regarding mental health concerns in their own words.

All data collected from the research surveys was analyzed by the researchers using data analysis tools within Qualtrics, ensuring the validity and accuracy of the results to appropriately support the study's three research questions.

Findings

Participant Response Rate

The researchers contacted eleven collegiate flight programs that offer a four-year professional pilot or similar flight degree option. After thirty-two days, responses were collected from 144 collegiate flight students. Of the 144 participants, 39 (27%) provided an additional comment at the end of the survey.

Collegiate Flight Students' Demographics

Question 1 of the survey asked each participating student to indicate their gender. Table 1 shows that 93 (65%) of the students indicated they were males, 51 (34%) of the students were females, and one student selected the third gender option, the other.

Table 1
Collegiate Flight Students' Gender

Gender	Responses	Percentage of Responses
Male	93	65
Female	51	34
Other	1	1

The second survey question asked each flight student to indicate which ethnicity best describes themselves. Table 2 shows that 128 (90%) students indicated they were White, three (2%) students indicated they were American Indian or Alaska Native, three (2%) students indicated they were Asian, three (2%) students indicated they were Black or African American, and three (2%) students indicated they were Native Hawaiian or Other Pacific Islander. Of the four remaining students, two (1%) indicated they were Middle Eastern or Northern African, and two (1%) indicated they were a Non-Resident Alien (of any race or ethnicity).

Table 2
Collegiate Flight Students' Ethnicity

Ethnicity	Responses	Percentage of Responses
White	128	90
American Indian/Alaska Native	3	2
Asian	3	2
Black or African American	3	2
Native Hawaiian/Pacific Islander	3	2
Middle Eastern/Northern African	2	1
Non-Resident Alien	2	1

Question 3 of the research survey asked each flight student to indicate their current marital status. Table 3 shows that 139 (97%) students indicated they were single (never married), three (2%) students indicated they were married, and two (1%) students indicated they were separated or divorced.

Table 3
Collegiate Flight Students' Marital Status

Marital Status	Responses	Percentage of Responses
Single (Never Married)	139	97
Married	3	2
Separated/Divorced	2	1

The fourth survey question asked each student to identify the class of FAA issued medical certificate they held at the time of completing the survey. In addition to those flying with a BasicMed alternative medical certification, which is not applicable to commercial operations, the FAA offers three classes of medical certificates to pilots (FLYING, 2022). Each of the three classes of medical certificates has varying requirements and years of applicability. As Table 4 demonstrates, 102 (70%) students held a first-class medical, 20 (14%) students held a second-class medical, 21 (15%) students held a third-class medical, and one (1%) student held the BasicMed alternative certification.

Table 4
Collegiate Flight Students' Medical Certificate Class

Medical Certificate Class	Responses	Percentage of Responses
First	102	70
Second	20	14
Third	21	15
BasicMed	1	1

The fifth demographic question asked each student to identify their total number of logged flight hours. Table 5 indicates 88 (62%) students had less than 200 flight hours. Of the remaining students, 51 (35%) had logged 200-299 flight hours, three (2%) had logged 300-399 hours, and two (1%) had logged more than 400 hours of flight time.

Table 5
Collegiate Flight Students' Total Number of Flight Hours

Number of Hours	Responses	Percentage of Responses
0-49	14	10
50-99	20	14
100-199	54	38
200-299	51	35
300-399	3	2
400+	2	1

The last demographic question asked the flight students to indicate which FAA pilot ratings and certificates they had earned at the time of the survey. In descending order of most frequent response, Table 6 shows 135 (94%) students had earned a private pilot certificate, 74 (51%) students had earned an instrument rating, and 41 (28%) students had earned a commercial pilot single-engine rating. Furthermore, 29 (20%) students had a commercial pilot multi-engine add-on rating, 13 (9%) students had earned a certified flight instructor rating, and eight (5%) students earned a certified flight instructor-instrument rating. None of the flight students indicated they had earned a multiengine instructor rating or a restricted Airline Transport Pilot (R-ATP) license.

Table 6
Collegiate Flight Students' Pilot Ratings and Certificates

Certificates/Ratings	Responses	Percentage of Responses
Private Pilot Certificate	135	94
Instrument Rating	74	51
Commercial Pilot Single-Engine	41	28
Commercial Pilot Multiengine Add-On	29	20
Certified Flight Instructor	13	9
Certified Flight Instructor-Instrument	8	5
Multiengine Instructor	0	0
R-ATP	0	0

Note: The total percentage of responses is greater than 100% because this question allowed the flight students to select more than one answer.

Collegiate Flight Students' Perceptions and Realities

The second section of the survey asked the flight students to indicate their own personal perceptions regarding student mental health concerns by answering fourteen Likert scale statements. Each statement had four options for the students to rank their perceptions, including Strongly Agree (SA), Agree (A), Disagree (D), or Strongly Disagree (SD). A summary of data from the Likert scale statements is presented in Table 7.

A four-point Likert scale for agreement with options ranging from strongly agree to strongly disagree was used by the researcher to force the collegiate flight students to form an opinion regarding mental health concerns. The four-point scale allows the researcher to get specific responses since there is no safe (neutral) option (ProProfs, 2023).

Table 7
Collegiate Flight Students' Perceptions Regarding Mental Health Concerns and Flight Training

Likert Scale Statement	SA	A	D	SD
As a collegiate flight student, I have noticed more prominent signs of anxiety, depression, and/or stress since beginning flight training.	38 (26%)	79 (55%)	21 (15%)	6 (4%)

As a collegiate flight student, at times, I have struggled to make my mental health and well-being a priority.	44 (31%)	73 (51%)	23 (16%)	4 (3%)
As a collegiate flight student, I feel comfortable taking mental health days off from my flight training.	8 (6%)	36 (25%)	58 (40%)	42 (29%)
As a collegiate flight student, I am concerned that if I told others that I occasionally feel depressed or anxious, then I would be grounded and would no longer be allowed to complete my flight training.	70 (49%)	50 (35%)	17 (12%)	7 (5%)
As a collegiate flight student, I have been continually depressed, anxious, and/or stressed about different events or activities in my life.	21 (15%)	63 (44%)	40 (28%)	20 (14%)
As a collegiate flight student, I have experienced continued obsessions and compulsions that cause distress or anxiety.	13 (9%)	53 (37%)	59 (41%)	19 (13%)
As a collegiate flight student, I have experienced sudden rushes of intense fear or discomfort (panic attacks).	9 (6%)	44 (31%)	44 (31%)	47 (33%)
As a collegiate flight student, when I am being observed or evaluated by others, I feel fearful, anxious, or nervous.	55 (38%)	70 (49%)	19 (13%)	0 (0%)
As a collegiate flight student, financial issues (flight costs) elevate my depression, anxiety, and/or stress levels.	52 (36%)	55 (38%)	28 (19%)	9 (6%)
As a collegiate flight student, FAA check rides/practical tests elevate my depression, anxiety, and/or stress levels.	78 (54%)	56 (39%)	8 (6%)	2 (1%)
As a collegiate flight student, I am aware that elevated levels of depression, anxiety, and/or stress can have a significant impact on my decision-making in the cockpit.	69 (48%)	66 (46%)	8 (6%)	1 (1%)
As a collegiate flight student, at times, I have been unable to become excited/enthused about anything related to flight training.	46 (32%)	60 (41%)	30 (21%)	8 (6%)
Being a collegiate flight student has negatively affected my overall mental health and well-being.	11 (8%)	41 (28%)	73 (51%)	19 (13%)

There have been times I have seriously considered quitting flight training because my depression, anxiety, and/or stress levels have become too overwhelming.	17 (12%)	40 (28%)	31 (22%)	56 (39%)

Note: Due to rounding, the reflected percentages in some Likert statements are greater than 100% of total responses.

Most students (81%) agreed they had noticed more prominent signs of anxiety, depression, and/or stress since beginning flight training. One of the students who strongly agreed with this statement added, "Personally, my stress/anxiety regarding flying is not chronic. However, since beginning flight training, my level of stress/anxiety has become more acute. Part of this is a combination of being a flight student, attending classes, having to work, and fatigue/burnout." Similarly, 82% of students agreed there have been times when they have struggled to make their mental health and well-being a priority.

Only 31% of students agreed they feel comfortable taking mental health days off from flight training. Regarding mental health days, one of the student pilots said:

> I think some of the collegiate flight schools have accepted too many students, and this causes added stress. In my case, we are only allowed two fatigue days a semester, but at the end of the day, we are college students, so that means there are days that some of us are up studying late or got up early that morning to fly. Flight students are stressed because we constantly must decide between studying for a test or sleeping for a morning flight. This can cause some major safety issues.

Moreover, most students (83%) agreed they would be concerned if they told others they occasionally feel depressed or anxious because they could be grounded and would no longer be allowed to complete their collegiate flight training. One of the participating flight students commented, "Even though I am mentally okay, I would never see a psychologist on the very small chance they would diagnose me with something that could be used against me from getting my medical." Another student added, "Student pilots are highly uncomfortable when talking about mental health due to the fear of the FAA getting involved. No matter what others say about protecting you, you can trust no one about this topic." Furthermore, a student stated:

> I have struggled with depression and anxiety but have been scared to see a university therapist since I do not want to be grounded and delay my flight training further than it already has been. I would love to get professional help and support but am not willing to risk my future as a pilot. I try to find different ways to handle my anxiety and depression such as meditation and daily journal writing.

Over half (58%) of the students agreed they have been continually depressed, anxious, and/or stressed about different events or activities in their daily lives. Conversely, about half (54%) of the students disagreed that they have experienced continued obsessions and compulsions that cause distress or anxiety. And 64% of students also disagreed that they had experienced sudden rushes of intense fear or discomfort (panic attacks) as a collegiate flight student.

Most students (87%) agreed they become fearful, anxious, or nervous when being observed or evaluated by others. Even more students (93%) agreed that FAA check rides and or practical tests elevate their depression, anxiety, and/or stress levels. Regarding check rides, a student commented, "There is the constant stress of failing a check ride or stage check. There is the added daily stress of messing up and the idea that any violation can go on your flight record, ruining your dreams of becoming an airline pilot."

Moreover, 74% of flight students agreed that financial issues associated with flight training elevate their depression, anxiety, and/or stress levels. A participating flight student stated, "I have been tempted to quit flight training due to the massive costs of flight training. Every year, it seems the school increases the flight costs. But I only experience stress regarding my financial situation, not depression."

And last, 94% of students are aware that elevated levels of depression, anxiety, and/or stress can have a significant impact on their decision-making in the cockpit. Although not directly related to decision-making in the cockpit, one student said:

> Having so many bad experiences with flight instructors has had a strong negative impact on my flight training and my mental health. I have thought about leaving collegiate flying because I am sick of being treated poorly while I am trying to learn. My university does not seem to do a thorough job screening their flight instructors before hiring them. Most instructors make very little effort to teach because they are only in it for the flight hours to get to the airlines.

And another student added:

> I have had two flight instructors go off on me and left me feeling awful because I made a simple mistake, or it was their lack of communication. Currently, I feel so uncomfortable flying with my instructor which has led me to feel even more anxious throughout my training flights because I am unsure of what might set them off.

Almost three-fourths (73%) of students agreed there are times they have been unable to become excited about or enthused about anything related to flight training. Regarding this statement, one student commented:

> We are all college kids, and college kids get stressed. However, there is an additional stress added to flight training. Lack of enthusiasm is common for me regarding my flight training. I constantly feel I am not having as much fun as I used to in my flight training since I am getting into the more advanced certifications, thus making flight only pertinent to learning. This adds stress to my daily life, but overall, I love flying.

Yet, 64% of students disagreed that being a collegiate flight student has negatively affected their overall mental health and well-being. However, one of the participating pilots stated:

> Collegiate flight training has affected me in an extremely negative way all because I can no longer be on medication that used to help me a lot. I hope things change because I want to fly, but the FAA is destroying any future pilot opportunities for me.

Similarly, 61% of students disagreed there have been times they have seriously considered quitting flight training because their depression, anxiety, and/or stress levels have become too overwhelming. One flight student provided an emotional response to this statement, stating, “Unfortunately, my passion for aviation has been almost completely drained to the point that it is hard to see a future for myself in the industry.”

Even though the researchers did not have the participating students respond to a statement regarding the effects the FAA, as a regulatory agency, has on a collegiate student’s mental health, surprisingly, many of the students provided individual comments. One of the students stated:

> The FAA has an archaic viewpoint on mental health issues that alienates current and potential pilots. Their refusal to update medical policies and listen to science and medical professionals will l continue to create serious safety issues as pilots attempt to secretly manage serious mental health issues.

And one student said:

> Due to the FAA and the aviation industry's backward approach to mental health, I have avoided taking reasonable measures to address general mental health and even mental health associated with the passing of family members. It is better to avoid generating any sort of paper trail related to mental health than actually address mental health and begin to repair it. As far as I know, there is no other industry that operates like this. Pilots should feel safe enough to seek the same reasonable care that anyone else would.

Last, a student added:

> The FAA has a long way to go in addressing mental health needs. Mental health cannot be ignored, and I find their policies about mental health to be absolutely barbaric. There needs to be systematic change from within before it can be accepted instead of being stigmatized. Far too many of us remain quiet, but another suicide is waiting to happen if the FAA does not change.

Conclusions

The findings of the study emphasized the connection between mental health and collegiate flight students with quantitative and qualitative data derived from a twenty-four-question survey. The participating students’ responses defined their perceptions surrounding the studied topic, in addition to demographics and other pertinent information.

Summary of RQ 1

Is there a stigma surrounding mental health within the aviation industry, specifically among collegiate flight students?

Mental health is a prominent issue for collegiate flight students. Eighty-one percent of students indicated they had noticed more prominent signs of anxiety, depression, and/or stress since beginning flight training. Furthermore, almost 60% of students indicated they have been continually depressed, anxious, and/or stressed about different events or activities in their daily lives.

Despite most collegiate flight students self-identifying their own mental health concerns, nearly 70% of students indicated they disagreed with the Likert statement, “As a collegiate flight student, I feel comfortable taking mental health days off from my flight training.” Surprisingly, 75% of the students agreed with the Likert statement, “As a collegiate flight student, I have noticed more prominent signs of anxiety, depression, and/or stress since beginning flight training,” and yet, most students also indicated they are not comfortable taking mental health days. This indicates flight students who have identified mental health concerns within themselves do not feel comfortable taking appropriate action to treat their mental health issues or make their mental health a priority. Furthermore, 81% of participants students agreed there have been times when they have struggled to make their mental health and well-being a priority.

Many of the students provided individual comments regarding their perceptions on the stigma surrounding mental health in aviation. Several participants commented on the FAA’s poor regulation of mental health and their perception the aviation industry’s *backward approach to mental health has caused them to avoid taking any action to address their overall mental health as collegiate flight students*. One of the students specifically referred to mental health as being a “taboo topic in a field where we are expected to be 100% physically and mentally fit.” Other students stated there needs to be a systematic change from within the FAA regarding mental health instead of it being stigmatized.

Summary of RQ 2

Does collegiate flight training create additional stressors that can exacerbate student mental health?

Although most students (64%) disagreed with the Likert statement, “Being a collegiate flight student has negatively affected my overall mental health and well-being,” the survey results show that specific aspects of collegiate flight training create additional stressors that can negatively affect the mental health of flight students.

Approximately 90% of students agreed they feel fearful, anxious, or nervous when being observed or evaluated by others. Moreover, 93% of flight students agreed with the Likert statement, “As a collegiate flight student, FAA check rides/practical tests elevate my depression, anxiety, and/or stress levels.” And similarly, 74% of collegiate pilots agreed that financial issues (flight costs) elevate their depression, anxiety, and/or stress levels as a flight student. The survey data was evidence that most collegiate flight students are depressed, anxious, and/or stressed due to many different contributing factors of flight training.

As a collegiate flight student, 94% were aware that elevated levels of depression, anxiety, and/or stress can have a significant impact on their decision-making in the cockpit. To make matters worse, several of the students added individual comments that identified their flight instructors as being an additional stressor in the cockpit. One student stated they had several instructors who would raise their voices when they became frustrated and that having so many bad experiences with flight instructors had a strong negative impact on their flight training experience and overall mental health.

Summary of RQ 3

Do collegiate flight students face external pressures that deter them from reporting poor mental health?

Eighty-three percent of participating students agreed with the Likert statement, "As a collegiate flight student, I am concerned that if I told others that I occasionally feel depressed or anxious, then I would be grounded and would no longer be allowed to complete my flight training." Over half of these students strongly agreed with this statement. Many respondents provided additional comments regarding this statement. One respondent stated, "There is no one who cares or is safe to vent to." Another student added, "There is an incredible stigma to having any mental health struggles because if they are reported on the medical, the chances of getting deferred by an Aviation Medical Examiner (AME) and being grounded is high." More than half of the students who left a comment acknowledged the fact they could not seek therapy or other treatments for their mental health concerns for fear of losing their medical certificate and being grounded by the FAA or their flight program. These results show a common theme among collegiate flight students that they are electing to leave their mental health issues untreated to avoid any delays in flight training.

The responses from the students also determined the FAA's strict guidelines regarding mental health issues are a major external pressure that many students face, and consequently, their mental health issues go unreported and untreated. Twenty-three percent of students providing individual comments specifically mentioned that they believe the FAA has failed to make mental health a priority for pilots. As a result, collegiate flight students are afraid of retaliation or being ignored if they publicly address their mental health concerns with others. One student stated, "The FAA is destroying the Gen-Z pilot opportunities," and another commented, "The FAA has a long way to go in addressing mental health needs."

Last, in response to RQs 1-3, 73% of the students agreed there have been times they have been unable to stay excited or enthused about anything related to flight training. As a result, 40% of the participating students have seriously considered quitting flight training because their depression, anxiety, and/or stress levels have become too overwhelming. Many students provided comments about their consideration of quitting flight training because there is a common lack of enthusiasm regarding flight training.

Conclusion of the Study

After analyzing the data, four significant findings emerged from the research study: (1) mental health, including depression, anxiety, and/or stress, is a prominent issue among collegiate flight students; (2) being observed or evaluated by others, financial issues (flight costs), and FAA check rides/practical tests are a main source of depression, anxiety, and/or stress in collegiate flight students (3) collegiate flight students find underreporting of mental health concerns to be more beneficial to their career than seeking treatment, (4) students believe that change is necessary and beneficial, as it relates to the current FAA medical certification process.

Collegiate flight students perceive that their mental health has become a more prominent issue since beginning flight training. Most flight students participating in this study have noticed more signs of depression, anxiety, and/or stress since beginning flight training, and almost half of the students have experienced continued obsessions and compulsions that cause distress or anxiety. And most students struggle to make their mental health and well-being a priority. Not only have mental health issues altered collegiate flight students' daily lives, but these issues have also affected their ability to stay consistently enthused about flight training. Almost three-fourths of participating students indicated there are times they have been unable to remain enthused about flight training. And close to half of the students have seriously considered quitting flight training because their mental health concerns have become too overwhelming.

Furthermore, the research data has shown that students choose to leave their mental health issues unreported and/or untreated to comply with the FAA's regulations regarding mental health. Most students are concerned if they told others they occasionally feel depressed or anxious, they would be grounded and would not be allowed to complete their flight training. This information presents the concern that student pilots are flying regardless of their mental state, which creates a major safety issue. Nearly all flight students reported they are aware that elevated levels of depression, anxiety, and/or stress can have a significant impact on their decision-making in the cockpit, and yet collegiate flight students are refusing treatment for their mental health issues despite knowledge of the risks and dangers associated with underreporting. Most students are intentionally not reporting or seeking treatment for fear of losing their medical certificate.

Recommendations

Based on the research findings, in addition to conclusions drawn from the students' individual comments, the researchers provide the following three recommendations.

<u>Recommendation 1:</u>

Eighty-one percent of the participating student pilots admitted it is a struggle to make their mental health and well-being a priority, to the extent that 58% of the students agreed it has affected events or activities in their daily lives. Therefore, collegiate flight students should identify positive mental health practices, such as peer support groups or hobbies (outside of flying), and make them as much a priority as their other daily responsibilities. One student commented, "It is so important for pilots, in particular, to practice good lifestyle habits to combat mental health." Incorporating mental health management techniques into their daily schedules not only educates them on proper mental health management but also makes them aware of the FAA's requirements regarding mental health and the medical certification process. This knowledge and awareness will help flight students achieve mental health goals both desired personally and required by the FAA.

<u>Recommendation 2:</u>

Additionally, collegiate flight training personnel, including flight instructors, should continuously promote mental health management practices to all flight students. Results of this study have shown that a flight instructor's attitude can directly impact a student's mental health. Many students voluntarily mentioned their flight instructors were a primary source of their mental health issues. One student provided explicit information regarding an experience with a flight instructor who consistently raised their voice in the cockpit, unnerving the student and creating an unsafe environment for both student and instructor. Flight instructors, young adults themselves, should be trained to identify and mitigate student mental health issues. Simple things such as (1) lending a listening ear, (2) requiring mental health days from flight training, and (3) remaining professional in the cockpit can help alleviate their students' mental health issues.

<u>Recommendation 3:</u>

Several students provided their individual opinions of current FAA regulations regarding mental health. A common perception among students was that the FAA needs to modernize its rules and regulations for obtaining a medical certificate, as well as being grounded for seeking advisement for mental health concerns. The researchers recommend that the FAA review and consider revising their rules and regulations regarding mental health. A willingness to revise outdated regulations related to mental health would make pilots, especially student pilots, more confident and trusting of the FAA and its required mandates. As a result, students would feel more comfortable with addressing their mental health concerns, thereby reducing depression, anxiety, and/or stress levels.

Recommendations for Further Research

1. Further research studies are necessary to determine how current FAA regulations and requirements for a medical certificate affect a student's ability or willingness to become a pilot or complete professional pilot) bachelor's degrees. Additionally, a study that determines whether students withhold or give dishonest information during the FAA medical process would provide valuable information. The results of this study could provide researchers with more understanding regarding collegiate flight students' perceptions of mental health and pilot medical requirements.

2. Another recommended research study is to survey US airline pilots who graduated from a collegiate flight program within the past three to five years to determine if they had similar mental health concerns in college. The findings would determine how these newly hired pilots coped with their mental health issues in college and if they continue to experience similar mental health issues with the airlines. The focus of this study could examine the airlines to determine if they incorporate mental health support programs into their flight operations and, if so, how productive and successful they are to the newly hired pilot.

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Time and Cost to Complete Instrument Training Based on Flight Block Times

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The optimization of flight training operations at higher educational aviation institutions can be helpful in increasing the efficiency at which student pilots attain their certification and help supply more pilots into the industry. Large training institutions usually offer students certain blocks of time to conduct their training. At these schools, the Instrument course is usually administered during daytime or nighttime flight blocks. The purpose of this research study was to analyze if there was a significant difference in the overall cost to complete the Instrument course during the day compared to at night. One independent sample *t*-test was conducted; the parameters selected were Two-Tail, with a sample size of 128. Archival data records of higher educational aviation institutions were analyzed, and the results show that it costs, on average, around $1,100 less to complete the Instrument course in night flight blocks compared to day flight blocks. This research paper demonstrated how flight block times can significantly impact the cost of completing the Instrument course at aviation universities and highlighted factors that led to these results.

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Introduction

Many university flight programs assign students to specific flight blocks. It is very common for a regular day to be split among blocks of about two hours, starting from around 6 a.m. up until midnight. Each semester, a student signs up for one of these flight blocks and gets an instructor assigned to conduct training activities during that specific block of time. For the purposes of this research paper, blocks from around 3 p.m. to 8 p.m. were grouped together and considered the daytime block (as they occur earlier in the day), while the blocks beginning around 8 p.m. and extending through midnight were combined and considered the nighttime block. As most flight blocks between Sunrise and 3 p.m. are reserved for flight courses that greatly require outside visual cues (like Private, Commercial, or Flight Instructor courses), the Instrument course is rarely administered before 3 p.m. For this reason, the first block of the Day group began at 3 p.m. The Instrument course of study at higher educational aviation institutions is comprised of a combination of one-on-one oral activities, simulator sessions, and flight activities; each of these activities is conducted in the specific block assigned between students and their instructors.

Per the Federal Aviation Administration (FAA) testing requirements, Private and Commercial pilot courses include flight maneuvers that must be performed primarily using outside visual references, most of which must be conducted during the daytime (FAA, 2018). The Instrument course, however, is almost entirely conducted with little visual reference outside the airplane but rather mainly by reference to flight instruments. For this reason, aviation colleges that have a high need for scheduling optimization can greatly benefit from placing Instrument students in nighttime flight blocks while reserving daytime blocks for Private, Commercial, and Certificated Flight Instructor (CFI) students.

Such a scheduling arrangement might be beneficial for the organization, but occasionally, students might be apprehensive about enrolling in a flight course that takes place at night. Factors such as fatigue, stress, and general discomfort from the lower visibility environment found at night may cause a negative impression on students if assigned a flight block later in the night compared to an earlier one.

Additionally, humans greatly depend on a 24-hour clock circadian mechanism to regulate bodily activities, coordination, and rest (Mahoney, 2010). Engaging in flight training outside of a normal morning-to-afternoon schedule could have an effect on students' sleep and eating schedules, as well as interfere with other classes, homework duties, or roommate schedules. Flying at night does pose some challenges to pilots, but it also may include potential benefits to students, especially in a high-volume training environment (Graeber, 1988).

Archival data from higher educational aviation institutions was used to make a comparison in the overall cost to complete the instrument training course between day and night flight blocks. An analysis of cost was made, which describes the overall amount paid from the start to the completion of the course.

Review of Relevant Literature

Regarding the progression of the Instrument course at higher educational aviation institutions, little is known about how flight block times and nighttime flying can play a role in the overall course of the training.

Night flying is demonstrated in literature to be more challenging to the human body than day flying. Burnside (2013) mentions how humans are naturally not well adapted to performing complex tasks in a low-visibility environment, which is commonly found at night. Nonetheless, flying at night can pose an array of benefits, especially if performed in the right conditions and with the right operational knowledge and equipment.

Although flying at night could be less attractive to students (especially as many of them have early morning classes or other scheduling duties), having the knowledge of how training efficiency changes according to flight block time can help students decide more carefully and informatively which Instrument flight block to sign up for.

The following literature covers a broad overview of sleep and how pilots are affected by the quality of sleep during the hours preceding a flight. Next, a study of the cognitive performance of several F-22 pilots flying during the day and night was reviewed, followed by an analysis of the sleep schedule and an overview of the potential drawbacks and benefits of flying at night.

How Quality of Sleep Affects Pilots

Flying is an endeavor that poses several challenges to pilots. As pilots are in ultimate control of the safety and outcome of the flight, it is important to ensure pilots are physically fit to act in their duties as Pilots-in-Command. The Illness, Medication, Stress, Alcohol, Fatigue, and Eating (IMSAFE) checklist is a method through which pilots can analyze if they are physically fit to fly, and sleep is one of these components crucial for aviation safety (FAA, 2023).

Drury et al. (2011) conducted a study to analyze how the amount of sleep affected pilots in regular air carrier operations. In this study, 302 legs of commercial flights were observed, and flight crews were observed and tracked for instances of Heightened Emotional Activity (HEA). Accident investigation reports continually point to the relationship between HEA and safety related aviation events, so the more amount of recorded HEA events in flights point to an increase in overall risk (Drury et al., 2011).

Captains and First Officers both had an average of about seven hours of sleep in the previous 24 hours, with a Standard Deviation between 1.18 and 1.43. Results showed that restricted sleep (less than five hours) was associated with higher instances of confusion, stress, and frustration. Within the previous 48 hours, restricted sleep (less than 12 hours) was associated with higher instances of unease and frustration (Drury et al., 2011).

These results demonstrate how restricted sleep can have negative consequences on flight crews and how important it is for pilots to ensure they have had sufficient rest before a flight.

However, this study did not specify what time of day pilots slept or if there was any difference in cognitive performance among pilots who flew during the day compared to those who flew at night.

Daytime and Nighttime Flying Comparison

Combs et al. (2021) conducted an experiment to analyze the psychological and cognitive performance of F-22 pilots during daytime and nighttime flying to determine if either situation was related to an increase or decrease in stress, performance accuracy, or test scores. Tests administered included the National Aeronautics and Space Administration-Task Load Index (NASA-TLX) inventory and a go/no-go (GNG) test. A total of 17 qualified F-22 pilots participated in a two-week-long experiment in which the researchers hypothesized that there would be a measurable difference in stress, performance, and overall exam scores among the two groups (day and night group).

Participants were, on average, 36 years old and had an average of 1,745 flight hours. Following completion of the experiment, neither group showed any significant difference in elevated cortisol levels (associated with higher stress levels). The authors also mention that these results observed were surprising, given that night flying is generally perceived to be more stressful than day flying; reasons that could have influenced these results include the fact that day flying requires more vigilance for traffic separation, is more susceptible to turbulence and G-forces, and is also subject to a more dense volume of traffic (Combs et al., 2021).

Two factors that were significant in this study are stress and cortisol levels, which were measured among participants as they relate to age and total time in aircraft. Participant age had a negative correlation with stress, as younger pilots tend to feel more stressed during flights than older pilots. Cortisol levels were also negatively correlated with total flight hours, showing how more experienced pilots tend to be more at ease during flight (Combs et al., 2021). Nonetheless, no significant difference was found in any of the measured parameters between participants who were observed flying during the day and those flying at night.

Sleeping Late and Alertness

Sleep and alertness are two crucial factors that affect pilots, especially while flying at night. But pilots engaging in nighttime flying also must alter their schedules to stay awake later in the evening and, in turn, wake up later in the morning/afternoon. In the early 2000s, a 21-year-old Australian army officer cadet who displayed severe instances of daytime sleepiness was diagnosed by two sleep specialists. His regular sleeping schedule was from 3 a.m. to 12 p.m.; the purpose of the diagnosis was to find what the cause of his excessive daytime sleepiness was, and if his sleeping schedule had any effect on his consistent drowsiness and sleepiness during the day (Smart & Singh, 2006).

The patient's sleep quality was tested through polysomnography (PSG) studies, and despite the officer’s later sleeping habits, there was no significant evidence of disruption to normal sleep. The patient was medically diagnosed, and instances of narcolepsy or idiopathic hypersomnia were both tested. It was considered that the patient most probably suffered from independent narcolepsy, delayed sleep-phase syndrome, and Idiopathic hypersomnia (Smart & Singh, 2006). Thus, his sleeping schedule alone did not play a role in his daytime sleepiness.

Drawbacks of Night Flying

Flying at night can be slightly more challenging to pilots due to the physical limitation that humans are inherently better at performing tasks in well-lit, high-visibility settings. While flying at night, pilots are susceptible to more vestibular and visual illusions than during the day. The Black Hole and Autokinesis illusions are only pronounced at night, and the Runway Width, False Horizon, and many of the other daytime illusions can be further intensified and more hazardous at night (FAA, 2023). As such, flying at night requires humans to compensate for the lack of performance in other ways (Burnside, 2013). Being more vigilant, combining inside and outside references more carefully, flying an instrument approach, or closely monitoring Runway Visual Glideslope Indicators are some of the ways that pilots can mitigate the risks involved with flying at night (FAA, 2023).

Other potential drawbacks of night flying include having to fly for longer hours, across various time zones, and across extensive featureless terrain. Staying alert and having sound knowledge and understanding of these factors and other pitfalls of flying at night can greatly help reduce the risk of encountering dangerous situations when flying at night. As most humans follow a 24-hour clock circadian mechanism under which bodily activities, coordination, and rest are regulated, flying during late hours could interfere with this natural daily body cycle (Mahoney, 2010). A common misconception is that sleeping late can induce more fatigue, even among healthy and experienced pilots. Nonetheless, as demonstrated in literature by Smart and Singh (2006), even with a sleeping schedule skewed to later evening hours, no difference was observed in fatigue, daytime sleepiness, or any other cognitive drawback in the tested participants.

Benefits of Night Flying

Previous research has shown how stress levels, fatigue, cognitive ability, and decision-making were not significantly different between pilots flying during the day compared to those flying at night. Results from Combs et al. (2021) demonstrate how there were no significant differences in reaction time, accuracy, test scores (NASA-TLX exams), and stress levels between day and night flying pilots. Moreover, stress response among daytime pilots was observed to be slightly higher than that of those flying at night, even though the researchers suggest a larger sample size would be beneficial to more accurately expand on the research (Combs et al., 2021).

Due to the dimensions of busy airspaces where various higher educational aviation institutions can be located, a very high number of training aircraft can be concentrated daily into a relatively confined area suitable for training and maneuvers practice.

Airspaces in the immediate vicinity of large airports can include Military Operating Areas, Restricted Areas, Special-Use Airspaces, and various Class B and Class C airspaces. Confined areas can cause a large number of training aircraft around these institutions to remain highly concentrated; many times, the volume of traffic in these areas is so high that they have been designated as Alert Areas on pilot Navigation Charts.

Traffic conflicts are common in these highly saturated locations. Many aviation universities have safety departments equipped with safety reporting systems and traffic conflicts consistently rank among the highest reported safety occurrences experienced by flight instructors and students. As evidenced in research, even highly experienced F-22 pilots are negatively affected by pressure to visually identify foreign conflicting objects and avoid them while flying, which is a key contributor to the activation of stress response while flying (Combs et al., 2021).

One potential benefit of night flying covered in the study includes the fact that the volume of air traffic at night is considerably less than daytime traffic. Traffic is a factor that greatly affects flight students in a training environment, as well as airspace congestion and air traffic control (ATC) delays. These can significantly increase the overall cost of conducting flight training operations (Houston, 2016).

In a statistical analysis of the busiest times at major airports across the world, Boromisa (2018) shows how the least busy times across airports are from 9 p.m. to 5 a.m. daily. Traffic considerably increases from 6 a.m. to 7 a.m. and is heavily saturated until 9 p.m. in nearly all airports analyzed. A student with an Instrument flight block during these times may experience significantly more delays than a student who has a flight block during the non-peak hours of the day. Since students are charged according to how many hours the aircraft's engine is running, ground and air traffic control delays significantly affect the overall cost of that flight activity.

Combs et al. (2021) also mentions turbulence as a potential drawback of daytime flying. During the day, the ground heats up and this causes the air to rise. Rising air, in turn, can create thermals across the ground, as well as generate an unstable atmosphere (FAA, 2022). As the sun sets and the ground cools, nighttime flying usually offers pilots a more stable atmosphere to fly in, characterized by fewer updrafts, turbulence, and instability.

Even among experienced F-22 pilots, repeated G-forces felt during daytime flying played a role in the increase in cortisol levels experienced by daytime flying pilots. Reasons for this can mainly be linked to prolonged sustained muscle contraction on the flight controls and more careful watch of flight instruments necessary for maintaining altitude and heading assignments (Combs et al., 2021).

One further potential drawback of daytime flying highlighted in the study conducted by Combs et al. (2021) was the need for increased vigilance for unknown traffic. Pilots rely on a concept called "See and Avoid." This means that pilots must always look outside for other traffic (as weather conditions permit) and take any necessary measures to avoid a conflict in their flight path. As the volume of air traffic is higher during the day, pilots must maintain a more careful scan during prolonged periods of time when compared to flying at night.

Methodology

This study aimed to analyze the training of Instrument Rating students at higher education aviation institutions in the United States and examine if there was a change in the overall course completion cost in U.S. Dollars for students who have flight blocks during the day compared to students who have flight blocks at night. The methods of measuring cost include analyzing the total cost for completion of the course. Although the institutions involved in this research will remain undisclosed, a few examples of large aviation universities in the U.S. include Embry-Riddle Aeronautical University, the University of North Dakota, Purdue University, and Auburn University.

An independent samples *t*-test was used to analyze if there is any significant difference in cost between students who have flight blocks during the day and night. As a *t*-test was conducted, the research analyses aimed to find differences between the two groups. Participants for these two groups were randomly selected. Although no physical contact was established between the researcher and the participants involved, IRB approval was received for the purposes of this research project. This annex will not be included to preserve the confidentiality of the institutions involved, per their request.

Participants were selected from a pool of students who had already graduated from their instrument course at aviation universities. Per G*Power tests, data from 64 students was required to be used in each group (day and night flight blocks) for a total of 128 participants. In order to ensure randomization, data was used from four previous academic semesters so as to include both Spring and Fall college terms. Using data from various previous semesters not only increased the sample size but also allowed more data from different students to be analyzed, thus increasing the randomization of the sample.

This research comprised data from 234 participants, exceeding the minimum requirement per G*Power tests. There was a total of 91 students in the day group and 143 students in the night group. The participants included male and female students of multiple different nationalities, including a majority portion from the United States, South Korea, Saudi Arabia, and India. The parameters selected for the test were Two-Tail, with an Effect Size of .5 and with an Alpha Level of .05.

All the students were de-identified, and their personal information (such as first and last names and student ID numbers) was known only to the researcher, which kept this data confidential. Furthermore, there were students who either had to repeat the course or switched flight blocks at some point during their training. The data from these students was not used; they were individually identified and deleted by the researcher. The only data used was from students who remained in a day or night flight block throughout the entire course of their Instrument training.

Descriptive Statistics

Means for completion cost were recorded in U.S. Dollars, as well as Standard Deviation, Range, and analyses of any potential outliers. The Means and Standard Deviation of the two reported groups between day and night flight blocks were then displayed through the use of bar graphs for easy visualization. Additionally, *t*-test outputs, bar graphs, and tables were added for easier interpretation of data. Although hourly rates might have varied slightly among institutions, the primary focus of this study was the relationship between Day and Night overall cost and not cost difference among different programs or institutions. As per the request of the universities involved, their identities and hourly rates must remain undisclosed.

The Day group was comprised of the flight blocks that began at 3 p.m. (and each lasted for two hours), as these flight blocks occur earlier in the day and are characterized by sunlight throughout most of the year. The Night group included the blocks that started at around 8 p.m., and each lasted for about two hours, as these blocks take place later in the night and are characterized by a generally dark setting throughout most of the year.

Hypothesis Testing

An Independent samples *t*-test was used to analyze if there was a difference in total completion cost. The following null hypotheses were tested: There is no significant difference in the cost of completing the Instrument course at higher educational aviation institutions between students who have flight blocks during the day compared to students who have flight blocks at night. It was assumed that the data was normally distributed, as the Dependent Variable was normally distributed. Participants were randomly selected, and the values of one student did not affect the values of any other student. There were no significant outliers, as the data from these students was not used. Equal Variance was tested through the SPSS output.

Results

This section presents the results of data analysis for this research project by highlighting the mean amount of money spent by students to complete the Instrument training. Hypotheses that were statistically significant were shown under both descriptive statistics and hypothesis testing sections. The section is composed of Descriptive Statistics first, followed by Hypothesis Testing. These sections include tables and graphs to better illustrate the numbers and values assessed in the various discussion topics.

Descriptive Statistics

The data used to obtain the cost of completing the Instrument course was sourced from higher education aviation universities. Although exact demographics information is not kept by the different flight schools assessed, a general record of registered student demographics can be generalizable to the flight departments. All of the participants were students enrolled in Undergraduate or Graduate courses of study at aviation universities, along with the Instrument course. Data was used from four semesters, to include both Spring and Fall college terms.

Table 1
De-Identified Small Sample of the Data Output collected from the Flight Departments

NAME	GROUP	BLOCK	DUAL	FTD	ORAL	COST
Student X	D	Day	31.1	41.1	47.3	$19,376.58
Student X	D	Day	48.5	32.7	32.6	$22,514.25
Student X	D	Day	41.9	42.8	25.1	$20,743.89
Student X	N	Night	31.2	25.9	19.3	$15,051.70
Student X	N	Night	40.3	37.2	22.4	$19,567.92

Note. Total Cost includes Oral, FTD (simulator), and Flight Time. Cost to complete the course.

Table 1 above shows an example of the data output collected for five of the 234 participants.

Table 2
Descriptive Statistics for the Cost of Completion of the Instrument Course

Flight Block	Variable	*N*	*M*	*SD*	*Min*	*Max*
Day	Cost	91	17366.13	2715.24	12368.97	23909.52
Night	Cost	143	16263.85	2040.50	12242.18	21307.33

According to Table 2, the average cost to complete the Instrument course during the Day (M = 17,366.13, SD = 2,715.24) was higher than the cost to complete the Instrument course at Night (M = 16,263.85, SD = 2,040.50). The timeframe for data collection included the Spring of 2023, Fall of 2022, Spring of 2022, and Fall of 2021. The lowest amount of money spent on the Instrument course during the day was $12,368.97, while the lowest amount of money spent to complete the Instrument course at night was $12,242.18. The highest amount of money spent on the Instrument course during the day was $23,909.52, while the highest amount of money spent to complete the Instrument course at night was $21,307.33. Table 3 below depicts the skewness and variance observed in the data regarding the cost to complete the Instrument course between the two flight blocks.

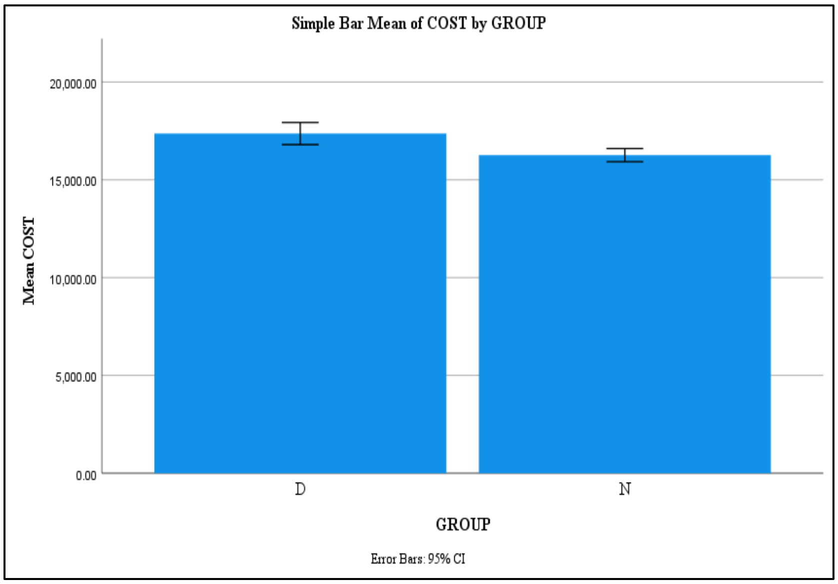
Table 3
Skewness and Variance

Flight Block	Variable	*N*	*Variance*	*Skewness*
Day	Cost	91	7372521.54	.371
Night	Cost	143	4163628.25	.203

Figure 2 below depicts the average cost to complete the Instrument course. The bar denoted as D depicts the Day flight block, while the bar depicted as N indicates the Night flight block. The Error Bars show how the data has small variability and that the mean is stable.

Figure 2

Average Amount of Money Spent to Complete the Instrument Course



Note. The letter D represents the Day group, while N represents the Night group.

A Shapiro-Wilk test was conducted to analyze the normality of the data used to determine the cost of completing the Instrument course. Although the data does not indicate normal as per the Shapiro-Wilk test, skewness does not indicate excessive departure from -1 to +1. Furthermore, since an Independent Samples *t*-test is a robust statistical analysis, the decision was made to continue with the experiment analysis through an Independent Samples *t*-test.

Table 4

Shapiro-Wilk Test of Normality

Group	Variable	*Statistic*	*df*	*Sig.*
Day	Cost	.139	91	.000
Night	Cost	.076	143	.043

For all the values used in these analyses, although the data was found to not be normally distributed, the decision was made to continue with the Independent Samples *t*-test for the reasons depicted above.

The values of one student did not affect the values of any other student. For the purposes of this research, the Dependent Variable was a continuous variable. The two groups were independent from each other, and the Independent Variable was categorical. There were two outliers in the Day group and one outlier in the Night group. The following table shows Levene's Test of Equality of Variance and how it is significant based on a value of $p < .001$.

Table 5
Levene's Test for Cost to Complete the Instrument Course

	F	*Sig.*
Cost	14.52	.000

The null hypothesis was that there was no difference in overall cost to complete the Instrument course at higher educational aviation institutions between students from Day and Night flight blocks. The assumption of equality of variance was tested. Levene's test of equality of variance was significant ($p < .001$), and thus, an adjustment to degrees of freedom was made.

The mean cost for completing the Instrument course at Night (M = \$16,263, SD = \$2,040) was lower than the cost for completing the Instrument course during the Day (M = \$17,366, SD = \$2,715). An Independent Samples *t*-test was significant at the Alpha Level of .05, $t(3.535) = 14.52$, $p < .001$. Therefore, the null hypothesis was rejected. Cohen's d = 0.207, which was a medium effect. Table 6 below shows the output results obtained from SPSS for the Independent Samples *t*-test. As the lower and upper values do not show zero, this depicts significant results.

Table 6
Output Results for Cost to Complete the Instrument Course

	t	*df.*	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*	*Confidence Interval Lower*	*Confidence Interval Upper*
Cost	3.32	153.73	.001	1102.28	331.86	446.68	1757.88

Discussion, Conclusions, and Recommendations

The findings in this research study show that at higher educational aviation institutions, it can be significantly cheaper and more time-efficient to complete the Instrument course during Night flight blocks compared to Day flight blocks. The significant results obtained from the *t*-test indicate that students, on average, spend more money to complete the course during the day compared to students who conduct the course at night. The parameters selected for the test were Two-Tail, with an Alpha Level of .05. The power chosen was .8. Several reasons explain these significant results; these will be discussed in the following section.

Discussion

As discussed in previous sections, day and afternoon times are generally peak times for air travel and air traffic control service requests. Having more air traffic not only reduces the capability of ATC to provide services but also increases delays experienced by pilots. With more traffic in the airspace, ATC must increase separation over a wider area, giving pilots more delayed vectors compared to a less busy time of day. More vectoring and reduced services can lead flight students to have incomplete flying lessons or spend more time in the airplane, which increases the overall cost of their training.

Other possible reasons for increased completion costs during the day include extensive ground delays experienced at airports with a high volume of pilot training. Upon the start of each specific flight block, there is an outflux of airplanes from aviation schools, many of which request departures at the same time. These airplanes, along with traffic from other flight schools, airline carriers, business jet traffic, and occasional military aircraft, cause significant delays for airplanes leaving the ramp and reaching the runway for takeoff (Park, 2020).

Turbulence and extensive vigilance required during day flying can also cause delays due to the need to avoid traffic or find suitable locations within the training areas for holding maneuvers or attitude instrument flying patterns. With more airplanes flying in these practice areas surrounding the home airports during the day, training aircraft must fly farther to conduct instrument maneuvers, as well as to practice instrument approaches.

In summary, the situations discussed above demonstrate how many reasons that cause an increase in flight time during the day are less prevalent at night. There is also usually a smaller number of aircraft flying at night, which prevents ATC from becoming saturated due to the volume of traffic. ATC is generally able to provide more radar services at night, allowing training aircraft to be able to practice instrument procedures more efficiently (such as holds and approaches) with fewer overall delays.

Departing from the airport for a flight presents fewer ground delays at night due to the smaller number of operations at an airport at night, allowing training aircraft to spend less time taxiing from the ramp to the runway. Inbound aircraft to the airport also experience fewer delays due to reduced vectoring by ATC, as there is less landing traffic. Furthermore, less turbulence at night, along with less need to fly farther within the practice areas, all contribute to less flight time required to complete the Instrument course at nighttime than during daytime.

Conclusion

A few notable conclusions were obtained from the analyses of the results of this study. The first conclusion is that a specific flight block can have a significant effect on the overall cost of completing the Instrument course. Flying in a night flight block can lead to a less expensive course completion compared to a daytime block. This was evidenced by the significant difference in means from the overall cost to complete the Instrument course during the day compared to completing the course at night.

Another conclusion drawn is that the time of day influences the cost of completing the Instrument course. The more hours of dual-given flight time a student logs, the more money that student will spend to complete the course. The results of this study contribute to the body of knowledge by adding insight into how flight training operations can differ, specifically regarding Instrument training as it relates to completion cost. These results show how student pilots are capable of accomplishing a training course at night with less money and in less time than completing the course during the day.

Nonetheless, a few limitations to this study include the fact that these results are only applicable to institutions that have a large body of students and that assign these students to conduct training in specific flight blocks. These results would not be generalizable to, for example, students of a smaller flight school that does not assign students to a specific block of time to conduct training. Another limitation is that hourly rates among institutions involved could have varied slightly; however, as previously mentioned, the primary focus of this study was the relationship between day and night overall cost, and not necessarily cost difference among different programs or institutions. The weather was also a limitation, as many parts of the country can be severely impacted by long periods of poor flying weather conditions. To minimize this, data from four different semesters was used in this research. Furthermore, there are other factors that were not analyzed in this study, such as the number of days taken to complete the course, that could significantly affect the course completion cost. Another limitation is that the data from only four semesters was used, and while the sample size was beyond what was required per G*Power tests, data from more semesters can provide a more robust test and stronger results.

Recommendations

Flight training is a very complex theme, and many factors can affect how quickly and efficiently student pilots can complete their courses. This research only examined the overall cost of completing the Instrument course. Future research can assess other factors, such as the time to complete the course measured in calendar days, cumulative days, or the amount of simulator or oral time.

Additionally, day and night groups are just one method of dividing the student training population; groups can also be classified through other methods, such as earlier, middle, and late blocks, or each individual flight block can also be assessed separately and compared against each other (for example, four groups [Day, Day, Night, Night] instead of the grouping of the two first groups and the two last groups together).

Other topics that can be assessed in future studies include whether there is any significant relationship between the number of days a student takes to complete the Instrument course and the overall cost of the course. Likewise, another topic for further research could include whether there is any difference in the overall calendar days to complete the Instrument course between day and night, early and late, or individual flight blocks.

Undoubtedly, the most significant recommendation from this study is directed at students of higher educational aviation institutions who just completed their Private Pilot courses and are in the process of signing up for an Instrument flight block. As students have the option to select their own flight blocks based on individual personal preference, the results of this research can supplement these students with information that can be helpful in this decision.

Many times, students must manage other classes, clubs, work, or extracurricular activities along with a flight block, and many of these only have the opportunity to pick a flight block that will not interfere with other scheduling duties. Other factors that might limit the choice of a specific flight block include excessive registration for a specific block, which could lead to a waitlist for that block.

Nonetheless, students who have the opportunity to choose from different blocks and are not affected by a waitlist or other conflicting scheduling assignments can use the results obtained from this research to make a more informed and educated decision on the specific flight block they will sign up for. Having the knowledge of how flight training can be affected by the time of day can also add to the body of knowledge in the literature by demonstrating how flight instruction and training operations can be conducted more efficiently and effectively during different parts of the day.

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Re-Imagining STEM-Based Aviation Education Through Alternative Knowledge Creation

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Boeing's workforce study suggests that the aviation industry is going to need over two million more people in the role of pilots, technicians, and cabin crew. Yet, according to the Federal Aviation Administration Civil Airmen Statistics, the number of women who hold the certificate required to fly for a major airline is still just above 4%. These two challenges, a potential shortage in individuals pursuing aviation careers and an industry that struggles to attract and retain underrepresented individuals, have the potential to be addressed if we re-imagine collegiate aviation education. This peer-reviewed practice article leverages a case study performed by Morrison and McNair (2023) to suggest new pedagogical strategies that would support the recruitment and retention of minoritized students to the industry. This analysis of the case study is supported by existing research into why the aviation industry continues to struggle to become more socially just and equitable and how collegiate aviation education is positioned to respond to that struggle.

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According to the Federal Aviation Administration (FAA) Civil Airmen Statistics, a little over 4% of women hold the certification that is required to be able to fly for a commercial airline (e.g., United, American Airlines, etc.) (Federal Aviation Administration [FAA], 2021). This number has remained similar over the past five years, with any small, incremental changes being almost statically insignificant. More importantly, these are not the only numbers that describe the ways in which the aviation industry is underrepresented by a (very few) number of minoritized groups. Sisters of the Skies (2024) indicates that less than 1% of pilots are Black women, and Lutte (2021) describes how the aviation industry, as a whole, is underrepresented by women. Her research describes how this is not just a problem with pilots but is impacting positions like air traffic controllers, maintenance professionals, and management, among others. Lutte describes what other researchers have noted, which is the aviation industry is both lacking representation by minoritized groups and is challenged to recruit and retain these individuals.

Howard and Kern (2019) note that careers requiring a STEM education are going to continue to grow, "Estimates indicate 75% of the fastest growing jobs will require STEM skills and more than one million additional STEM graduates will be needed over the next ten years" (p. 1136). Aviation is but one example of a Science, Technology, Engineering, and Mathematics (STEM) industry that is also growing exponentially. According to Boeing (2024), over two million pilots, technicians, and cabin crew will be needed over the next 20 years in order to keep up with the global demand for air transportation or air travel. If these are the needs of STEM industries (including fields like aviation), then finding ways to attract talent that has historically been underrepresented is critical. It is evident that there is a need for more people, but that the recruitment and retention of minoritized individuals is slow to progress and will not keep up with the rate at which the industry needs these professionals.

In response to this demand for an increased number of professionals, a growing number of researchers suggest that outreach and education will enable the recruitment and retention of more diverse groups in the field of aviation. However, aviation education encounters many of the same challenges that are faced by the industry as a whole. An overreliance on performative efforts rather than substantive change is a challenge that both education and the industry contend with. Howard and Kern (2019) write, "Schools are entrenched in larger systems that mirror what society values; therefore, teachers implement content, skills, and underlying values that are influenced by their administration, policy, and society as a whole" (p. 1136). In other words, despite the fact that collegiate programs are needed in the effort to create a more socially just workforce in aviation, they may not be prepared to undertake these efforts. In order for collegiate aviation programs to be a part of the solution of creating and sustaining an industry that is socially just, equitable, and addresses the workforce challenges identified by Boeing, it is incumbent for these programs to reflect on the ways in which they currently and historically continue, to reinforce systems of oppression which strengthen barriers to access for minoritized groups.

One way that aviation education might be able to undertake this issue is through the pedagogical strategies it uses in its classrooms. Imagining a different way of approaching the pedagogical practices in aviation and STEM education has the potential to impact the industry by introducing young professionals who have new ideas and are prepared to be innovative in their approach to working in the industry. This paper presents a position on what aviation and STEM education might look like if it were to consider alternative forms of knowledge and knowledge creation as part of its educational practices. By applying feminist pedagogical practices to a field that has predominantly relied on Western Enlightenment thinking and similar strategies to educate some and minoritize others, there is the potential to create an educational system that is more equitable and socially just and addresses the future workforce challenges.

Positionality Statement

The project of transforming education and its systems requires that researchers invest their time in the process of self-reflection. Imagining and transforming STEM education is not possible without considering the ways in which individuals' identities impact or influence the research questions they develop and how they engage with the research process itself. This is particularly important and valuable in fields where there is a long history of minoritizing certain groups and individuals. In order to overcome and transform those systems, researchers, educators, and professionals must have the ability to self-reflect on their own positions (within the aviation industry). Without this self-reflective work, one cannot begin to imagine the possibility of 'doing things differently.'

Holmes (2020) argues, "Positionality describes an individual's worldview and the position they adopt about a research task and its social and political context" (p. 1). He indicates that our values and beliefs about where knowledge comes from, who creates it, our interactions with the environment, and the process of conducting research itself all influence research practices. Because of this, it is important for researchers to reflect and acknowledge the ways in which their position influences decision-making within the research process.

To that end, the author is a white, middle-aged, cisgender, heterosexual woman with a spouse who works for a major airline in the United States. They hold multiple graduate degrees, including a doctorate in the field of Education, Policy, and Leadership. These are certainly not all of her identities, but they have influenced the ways in which she engages with the topic of aviation education, the kinds of questions they find themselves asking about, and what it means to imagine a different approach to how we teach in collegiate aviation programs. Being the beneficiary in a system that has prioritized Western Enlightenment thinking and pedagogical practices that value assessment and "rote memorization," The author acknowledges that she has to continue doing her own work of imagining new methods and pedagogical practices that would enable education and specifically aviation education, to be more accessible to groups who have historically been underrepresented.

The author wishes to acknowledge that while their position has afforded them a great deal of access and the ability to research and publish on a variety of topics, they have also found themselves to be limited in access. The author does not have a traditional (or "acceptable") aviation background, and in fact, not having the 'credentials' of a pilot's license or dispatch certificate or some form of certification in the industry has often been a limitation. Aviation, as a field, really struggles to find value in people, experiences, and ideas that do not come from traditional aviation backgrounds. This is what has led to her research and interest in creating a more socially just aviation industry and her desire to see more diverse voices within the industry.

The History of Aviation in the United States: The 30,000 ft. View

The story of the Wright brothers and their first flight is a piece of history that is well-known and understood by the general public. What is less known or understood by the general public is the ways in which the United States has used aviation as a means to ensure or solidify its own authority globally. Van Vleck (2013) writes, "The airplane, of course, was also a conduit of power-military, economic, and ideological-and the nation's worldwide infrastructure of commercial air routes, along with its hundreds of oversees air bases, proved critical to its twentieth-century ascendancy" (p. 3). The commercial enterprise of aviation was slow to take off, yet the role of aviation and the airplane in the United States military is one that found its roots almost immediately.

It can be argued that this connection of the airplane to the military (and perceived global power and authority) is one of the reasons why commercial aviation, and in particular, airport spaces, remained one of the last to truly desegregate in this country. This is troubling because of the ways in which airports and airplanes were connecting and shaping consumers. Ortlepp (2017) writes, "America's increasing reliance on air travel as a mode of mobility expressed shifts in consumer culture, left an imprint on material culture and the built environment, and contributed to the formation of individual and collective identities" (p. 3). Commercial air travel was not just about the ability to travel from point A to point B more effectively; it was also a mindset and a way of engaging with American life as a consumer. The impact of airplane and air travel on consumerism and capitalism was not unlike the advent of the Ford Model-T, where the ability to participate in the economy as a consumer grew dramatically.

Unique to the development of the airplane and air travel was its simultaneous connections to the military and global power and authority. Air travel, while it had a significant impact on consumer culture, was also deeply connected to notions of the superiority of Western cultures and ideals. Van Vleck (2013) continues:

> America's views of foreign peoples and places, then, did not necessarily change after the airplane allowed them to see and to know the foreign firsthand. In the case of the Army pilots, the diplomatic and military officials who assisted them, and the journalists who covered their travels, encounters with the foreign tended to confirm preexisting beliefs. (p. 39)

In spite of the globalizing effect of the aviation industry, which brought access to people and places around the world, colonial and settler colonial attitudes are still deeply embedded within the aviation industry. As Van Vleck identified, the creation of the airplane served to reinforce the belief that American ideals, particularly those around capitalism and the free market, were important to export around the world. Commercial air travel would ultimately leverage these ideas as it expanded to the general public.

This focus on what aviation could do for the economy is one of the reasons that the industry continues to rely on performative measures of advocating for diversity, equity, and inclusion. The struggle to really understand and implement equitable practices is the direct result of how air travel was valued for its importance and impact on the economy. It is also the reason why the industry remains challenged to bring more women and other minoritized groups into aviation careers. Education has the ability to transform these attitudes upheld by the industry. To continue to educate in ways that have upheld systems of oppression, without imagining how education could indeed be transformative, is a method by which inequitable ideals are reinforced and upheld. Imagining new and innovative pedagogical strategies is what will push the industry toward a more equitable future.

How Diversity Efforts (Can) Reinforce Oppression (Especially within Higher Education)

Higher education institutions face significant challenges when it comes to the idea of implementing diversity and inclusion efforts. Since the murder of George Floyd in the summer of 2020, institutions are making a more significant effort to become more diverse, inclusive, and equitable – or so they claim. However, saying that change in the institution needs to occur is not the same as actually making that change a reality. Unfortunately, many higher education institutions have fallen into the business of "performative" diversity. To be performative suggests that change need not occur within institutions. It just needs to give the appearance that it has changed or that change is on the horizon. Brayboy (2003) writes:

> To advance the agenda of diversity, institutions that truly value diversity must move towards considering wholesale changes in their underlying structures and day-to-day activities, especially if they are committed to refocusing the historical legacies of institutional, epistemological, and societal racism that pervade colleges and universities. (p. 74)

What Brayboy acknowledges is that real, systemic change is something that takes work, dedication, and, often, a complete overhaul of a system that has long been in place. It is not enough to simply say that diversity is important to the institution. Brayboy (2003) also recognizes that the tendency of predominantly White institutions (PWI) is to look at the numbers of faculty and students of color across campus and to make assumptions and judgments about their diversity efforts based on those numbers. The response is often that the institution needs to hire more faculty of color in order to demonstrate support for diversity and inclusion efforts. What Brayboy understands is that with these hires comes the commodification of the faculty of hire. These individuals become the ones responsible for implementing and managing diversity efforts, often to the detriment of their own promotion and tenure. Focusing on the implementation of diversity efforts is a type of "hidden curriculum" that higher education institutions disproportionately assign to faculty of color and is, more often than not, a service that is not counted towards their tenure and promotion (Brayboy, 2003). It ultimately becomes labor that is expected of them (as representatives of a minority group) but for which they do not receive any credit or acknowledgment of having performed.

Part of the difficulty in implementing diversity and inclusion initiatives is the desire of institutional spaces to maintain the status quo. Many of these organizations will make claims to the importance of diversity and inclusion without also desiring to make fundamental, long-term changes to the system. Ahmed (2007) echoes this by acknowledging how universities have come to focus their efforts on the documentation of diversity and inclusion. She talks about how documents become 'things' that circulate within institutions. In this way, the document – and the act of documentation become another mechanism of performativity that organizations have come to rely on. Ahmed (2007) writes: "I want to consider how documents become forms of institutional performance in two senses. They are ways in which universities perform an image of themselves, and they are also ways in which universities perform in the sense of 'doing well'" (p. 594). Ahmed recognizes that the implementation of diversity through its documentation often turns into another way in which an institution can maintain the status quo. The document becomes something that an organization can point to and claim 'success.'

The notion that institutions and higher education institutions, in particular, are somehow better equipped to respond to issues of creating and sustaining spaces that are more socially just is challenged by Ahmed (2012) in her book *On Being Included: Racism and Diversity in Institutional Life*. Ahmed is critical of the assumption that diversity and inclusion efforts are necessary to make the kind of transformative change to its systems that will result in more equity and social justice. Her research suggests that there is a fine line between making substantive changes and the performance or appearance of support for diversity and inclusion efforts. She (2012) writes, "For these scholars, among others, the institutional preference for the term 'diversity' is a sign of the lack of commitment to change and might even allow organizations such as universities to conceal the operation of systemic inequalities" (p. 53). In other words, the term diversity can become a mechanism by which organizations are able to maintain and sustain the status quo. Between the documentation and the performative 'efforts,' institutions are able to point to something that allows them to feel comfortable in their inaction. Suddenly, diversity and inclusion are a means to continue the systemic inequality rather than introducing transformative change, which is necessary to create a more equitable and just workforce.

If little substantive change comes from these efforts, the question becomes, "what is the point." In aviation (like in higher education), diversity and inclusion are concepts that the industry continues to place a priority on (CNN, 2022). Yet, if no transformation, if no substantive difference is being made, what is the point? Ultimately, I argue that the ability to lean on performative efforts ***is*** the point of diversity and inclusion activities. Performative efforts enable the university to appear as though it is making a difference without the accountability of having to make any substantive changes.

The aviation industry, not unlike higher education, uses performative measures to suggest that they are supportive of diversity, equity, and inclusion efforts. Morrison (2023) argues that an overreliance on performative measures can be a challenge because it does not offer substantive change in relation to the experiences of minoritized groups. As noted previously, with the potential for workforce shortages, understanding how to recruit and retain more minoritized individuals is imperative. Therefore, a reliance on performative measures is not enough of a step for organizations to take. Real change needs to occur in order to respond to workforce challenges.

One way of responding to the performative is to consider the pedagogical practices of aviation education. This has the potential to introduce new methods that would generate a more diverse, inclusive, and equitable aviation industry. How we educate the students who wish to pursue careers in the industry is connected to the ways in which they engage with the field and their understanding of what it means to be an aviation professional.

Re-imagining Aviation Education

Given the challenges that both the aviation industry and higher education institutions face, how can aviation education programs approach the project of reimagining their pedagogical practices to support diversity and inclusion efforts that would transform the industry? One consideration might be to understand the methods that the industry currently relies on and how these methods do or do not support creating and sustaining a more equitable industry.

Education, as it currently functions in the United States, has a tendency towards favoring Eurocentric norms, which have a long history of minoritizing certain groups of people. This is where the project of decolonizing education systems can be useful. Sappleton and Adams (2022) write:

> First, we consider decolonization as both a global geopolitical and an intellectual process. Both processes are engaged in dismantling cultural, economic, and political artifacts within previously colonized and settler colonial areas. It entails confronting, interrogating, resisting, and disrupting colonial endeavors (physically, psychologically, and ideologically). This includes a paradigm shift away from favoring Eurocentric norms, views, and embedded social structures to (re)centering) the experiences and voices of the historically marginalized. (p. 45)

Aviation, as an industry, was founded on the premise that airplanes could enable the United States to access the world and spread its ideals through colonialism (Van Vleck, 2013). This attitude within aviation, which embraces expansionism, is directly connected to its challenges in trying to effectively implement efforts focused on diversity, equity, and inclusion. Embracing diversity, equity, and inclusion requires that organizations are self-reflective and able to deconstruct the ways in which (their) institutions continue to maintain systems of oppression. Colonial and settler colonial attitudes embrace the belief that 'the West,' in this case, the United States, is within its rights and authority to leverage aviation in ways that maintain the oppression or minoritization of certain individuals. The outcome of decolonization is to transform spaces (for example, education) so that they no longer operationalize systems of inequality.

One of the ways that decolonization, or the critical engagement with settler colonial attitudes, can occur is through the evaluation and analysis of educational or pedagogical practices. So, what does it mean to reimagine the pedagogical practices of education? Howard and Kern (2019) write, "Schools are entrenched in larger systems that mirror what society values; therefore, teachers implement content, skills, and underlying values that are influenced by their administration, policy, and society as a whole" (p. 1136). In other words, one does not simply change schools and the pedagogy of how we do "schooling" in the United States. It is deeply connected to our society, and the system itself is much larger and has a greater impact than any one individual school. In the case of aviation education, as it relates to the larger project of STEM education, Howard and Kern (2019) are clear about the ways in which this education has been designed to reinforce certain values and belief systems that are the result of colonial systems of oppression.

> While the United States government, educational institutions, and society at large have placed an emphasis on increasing interest and performance in STEM, it is worth noting that particular variety of STEM that is generally valued, and therefore taught in schools, is Eurocentric inn nature and containing 'distinct neoliberal values.' (p. 1136)

They articulate how there has been an increased push, particularly from the United States government, to support initiatives that desire an increase in the number of students who are pursuing STEM degrees. Despite the goal of getting more students into STEM fields, the most frequently used approach to teaching in STEM is decidedly Eurocentric. There is an overemphasis on assessment, memorization, and not valuing knowledge creation or generation that does not rely on these methods. Experience and other forms of qualitative knowledge are often less valued, or they are seen as secondary to more quantitative methods. This reliance on Eurocentric or Western Enlightenment approaches to education is in direct contrast with the desire to attract and retain minoritized students.

The reliance on one model of teaching does not enable STEM disciplines to become more inclusive or to incorporate different or alternative types of knowledge. By leaving these ideas and ways of knowing out of a STEM education, students are being exposed to these fields from one kind of knowledge base – that has its foundations in Western Enlightenment thinking. Howard and Kern (2019) reinforce this, writing, "and we would also argue multiple ways of knowing/being/ valuing in STEM is a vital component to success. Indigenous ways of knowing are simultaneously ancient and contemporary and inform cultural understandings of community and place" (p. 1139). Instead of only relying on the success that is defined in terms of assessment through grades, Howard and Kern are making an argument for the importance of alternative ways of knowing and understanding within STEM fields.

One of the ways in which the project of reimagining aviation education might be advanced is through what Sappleton and Adams (2022) describe as concepts that are adjacent to or include decolonization, "Second, while decolonization is an older and much broader tradition than the relatively new antiracism emphasis, we consider these less as distinct or unrelated concepts. Rather, we view the latter as a mechanism for advancing the former" (p. 46). Morrison (2019) reinforces this, "If we want engineering education as a field to be innovative in how it researches and engages with the student experience, then it cannot just shift the default for education research; it must consider both its methodological practices and pedagogies" (p. 3). To transform STEM and aviation education, more consideration needs to be given to the totality of the student experience within the field. Imaging new ways of teaching and learning in the field will enable aviation education to become more socially just and equitable. In other words, the pedagogy that we use must reflect and value the many ways that knowledge is created and shared.

Feminist Pedagogical Practices as Alternative Teaching Methodology

Considering new methods for how (and what) is taught in schools is a component of 'alternative knowledge creation.' By 'alternative,' feminist and Indigenous scholars refer to knowledge creation that does not rely on the methods that arise from the more traditional Western Enlightenment thinking.

One way of imagining new pedagogical strategies can be done by looking at the work of Black Feminist scholars. These scholars have long written and theorized about education and its role in the liberation of individuals. Bell Hooks has written extensively about the ways in which education can (and should) have a transformative power with its students and within societies. Hooks (1994) writes:

> To educate as the practice of freedom is a way of teaching that anyone can learn. That learning process comes easiest to those of us who teach who also believe that there is an aspect of our vocation that is sacred; who believe that our work is not merely to share information but to share in the intellectual and spiritual growth of our students. (p. 13)

Hooks describes a kind of education that was collaborative and invested in transformation and liberation. The kind of education she is describing is one that resisted the "banking model" of education. The banking model of education relies on teachers pouring information into their student's heads and hoping that they might be able to recall that information. It is a model of education that supports systems of assessment and accountability. It also supports the treatment of the individual as a worker in a capitalist society, not someone who is going to act in ways that support transformative change within institutions. The 'banking model' is not a form of pedagogy that necessarily supports innovation and creativity.

Similar to bell hooks, for Freire (2018), education and pedagogy, in particular, are key to transforming systems of oppression and creating more socially just societies. He (2018) writes, "This pedagogy makes oppression, and its causes objects of reflection by the oppressed, and from that reflection will come their necessary engagement in the struggle for their liberation. And in the struggle, this pedagogy will be made and remade" (p. 48). Freire articulates that education and pedagogy, when created in collaboration with the oppressed, have a higher likelihood of leading to liberation. It was through this kind of liberation that (we) could collectively come to the humanization of those who had historically been marginalized. Both Hooks and Freire advocated for an education that led to liberation – and that it was only through this education that the individual could move away from systems of oppression.

The challenge to imagining innovative pedagogical strategies is that these are not the ways in which education is currently valued and or executed. Vergès (2018) correctly articulates that pedagogy "had been progressively contaminated by the corporate lingo of 'outcomes'" (p. 92). Arguably, the focus on outcomes and assessment is a means for maintaining and promoting the status quo. In the same way that institutions utilize performative efforts to demonstrate support for diversity and inclusion, the focus on assessment and outcomes in current pedagogical practices is a method that is used in educational systems to maintain systems of oppression. A focus on outcomes and assessment limits the pedagogical practices of educators, which reinforces the status quo and limits systemic change. This is why both Hooks and Freire argue that education needs to be rooted in its transformative abilities to liberate the oppressed. Vergès continues on to write about a pedagogy of emancipation. All of these terms, emancipation, transformation, and liberation, describe a system of education that does not maintain the status quo but is an active method by which we might reimagine education – and aviation education.

Alternative Knowledge Creation and the Value of Experience

Feminist scholars also tend to support the idea that experience is a means of knowledge creation or generation. It is this belief in the value-added and consideration for an experience that contributes to the creation of knowledge through alternative means. The incorporation of pedagogical practices that support innovations in knowledge creation enables more individuals who have historically been marginalized to contribute to their respective fields. Educators in STEM fields and aviation might consider other ways of teaching subject matter that would encourage individuals who have long been minoritized or marginalized by the industry. The question is how we move towards a pedagogical practice that is more inclusive in order to support individuals and the industry. There is evidence that supporting educational practices that do not rely on traditional Western methods have the potential to transform the industry. Elkin Mohler (2017) wrote:

> Students have been mainly educated in the Western tradition within the United States education system. Despite differences in their ethnic, cultural, and socio-economic backgrounds, most of my students have neither been exposed to non-Western modes of thought nor have they spent time critically analyzing their own biases. One of my goals is to give my students some tools with which to begin to consider what one's worldview and how it impacts one's life and other" (p.93).

Mohler describes the importance and relevance of educating students in a way that brings others' experiences and worldviews into conversation with their own. She describes how only being exposed to one kind of education can be limiting for students. Without being introduced to other ways of thinking and experiencing the world, students can become limited by their own biases.

Edwards (2017) writes about her own experiences as a student and her instructors' emphasis on learning through Indigenous ways of knowing. "As an educator, it reminds me to reach beyond the narrow confines of pedagogy imposed by the Western obsession with standardized curriculum and assessment. As a researcher, it encourages me to examine education in ways that honor Indigenous modes of inquiry, despite deep-rooted institutionalized biases towards positivist methodologies" (p. 66). This type of knowledge creation places a high value on the individual's experience as a contributor to how they engage the world around them, rather than relying solely on the scientific method, assessment, and other more traditional methods of knowledge creation.

Morrison (2019) argues that incorporating the pedagogical practices of other fields, including art education, or specifically Indigenous art education, is one strategy for enabling alternative knowledge creation and supporting the education of minoritized individuals. Research and experience in the classroom demonstrate that an overreliance on standardized testing, assessment, and traditional Western pedagogy does not enable students to become well-rounded professionals. This, in turn, has a limiting effect on who pursues and is retained in the aviation industry.

Community-Based Learning Group: A Case Study of Women Pursuing Aviation Careers

What is alternative knowledge creation? What does it involve, and how does it contribute to reimagining an entire system or pedagogical style of education for a particular field, and why is this consideration important? In the case of STEM and aviation education, there is a long history of valuing one kind of education over another, a preference for one kind of knowledge creation. In response to this, Morrison and McNair (2023) designed a study that worked with a cohort of collegiate women who were pursuing an aviation career from a variety of fields (public policy, engineering, geography, etc.). The primary purpose of the cohort was to understand how a cohort of women might experience and articulate their sense of self-efficacy as it related to their choice to pursue an aviation career and the challenges they had experienced while pursuing a degree in that career.

What the research team found in collaborating with these young women was that many of them felt more confident in pursuing a career in a predominantly male industry when they had the opportunity to connect with other women who were pursuing a career in the same field. In other words, the cohort was ultimately about their experiences and the ability to share those experiences with one another. This connectivity is what was valuable to their sense of self-efficacy. (Morrison and McNair, 2023) These young women expressed gratefulness for being a part of a community that they felt was going to support them in this pursuit of an aviation career and articulated how challenging it could be to work towards a career in an industry where they were part of a minority group. Through the cohort, the participants were gaining knowledge about working in the aviation industry that originated from the community (alternative knowledge generation). One woman stated:

> The challenge I foresee is that this field is very much male-dominated. I am concerned with having to deal with a lot of gender and age bias. There are times in my job now that I really struggled with older male individuals that tried to tell me I was wrong when I knew why the issues was occurring and how to fix it. (Morrison and McNair, 2023, p. 45)

Women in aviation careers expressing feelings of being ‘othered’ is not uncommon and was echoed in the work of Lutte and Morrison (2022), who discovered that many women considered leaving the aviation industry and their careers because of how they were made to feel that they were not welcome or included in that industry. One woman, describing her experience working in the aviation industry, was told by a colleague: “You’ll never really be one of us.” (p. 7). Their project discovered that one of the primary reasons that women have considered leaving or have left the aviation industry was because of the existence of a “good old boys’ network.” (Lutte & Morrison, 2022)

This project also discovered that outreach to young women played a role in their recruitment. Further, mentorship, by either women or men, had a role in an individual’s retention within the industry. These findings support what Morrison and McNair (2023) found with their cohort of women, that both outreach and mentorship have a role to play in the recruitment and retention of women in the aviation industry.

In other words, finding a way to create and support a community for minoritized groups is one way in which they might be both recruited and retained in the industry. Community is a means by which individuals can feel support when challenged by working in industries that have not traditionally been supportive of minoritized groups.

Conclusion

Thinking critically about pedagogical strategies and how educators are engaging with students in aviation programs is going to be one method by which aviation higher education programs respond to the continued workforce challenges faced by the aviation industry. In order to address the workforce shortage challenges, it is necessary to consider how to create a more equitable and socially just workforce environment. To do so requires aviation higher education to engage in reflective practices that consider the ways in which (they) are maintaining the status quo and reinforcing barriers to entry, which prevent the recruitment and retention of minoritized individuals from pursuing this field.

By considering which pedagogical strategies are used in the classroom – and utilizing those that would support all students in the classroom, aviation education can become a method by which the industry is able to address its workforce challenges. Consideration for innovative teaching methods would have the potential of retaining more students who would eventually enter the aviation workforce.

One example of a potentially successful strategy that aviation higher education might consider is creating more opportunities for students to build or establish a community. The chance to create community provides an opportunity for students to engage with peers and see the ways in which community – and a sense of belonging - can reinforce and support their long-term goals.

The challenges to the aviation workforce, namely those related to retention and equity, cannot be addressed by the industry alone. Higher education institutions also have the opportunity to make positive contributions to the aviation workforce by evaluating the traditional systems of education, which have not resulted in either 1) a more equitable workforce or 2) one that can keep up with the critical need for more personnel. It is through this collaborative effort – and a willingness to self-reflect on long-accepted practices, which will ultimately address workforce challenges and be more likely to create something that is equitable and socially just.

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Examining Moral Conduct in Aviators Through the Lens of Immanuel Kant's Perfect and Imperfect Duties

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This paper focuses on Kantian ethics, explicitly exploring the implications of Kant's perfect and imperfect duties within the aviation sector. It analyzes how these ethical principles apply to pilot behavior and their impact on safety, professionalism, and trust within flight operations. This paper argues for a culture of integrity and responsibility among aviation professionals and highlights the criticality of ethical leadership concerning pilot performance. Additionally, it outlines potential areas for future research, including empirical studies on pilot behavior and the development of targeted ethical training programs for flight crews, aiming to enhance ethical standards and practices in aviation.

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In professional ethics, few domains demand rigorous adherence to moral principles as much as the aviation industry. Pilots entrusted with the lives of passengers and the safety of their crew operate in an environment where the most significant risk of ethical violations can be fatal. Within this context, the ethical framework provided by Immanuel Kant, particularly his distinctions between perfect and imperfect duties (Hochberg, 1974; Johnson & Cureton, 2022; Kant, 2017), offers a profound lens through which to examine the conduct of pilots. Kantian ethics, with its emphasis on duty, moral law, and the categorical imperative, provides a structured approach to ethical decision-making that rationalizes the moral responsibilities of pilots not only to their passengers and employers but also to their colleagues and the broader aviation community.

This paper explores the nuances of Kant's perfect and imperfect duties and their relevance to the aviation industry. According to Kant, "perfect duties" are moral obligations categorically binding under all circumstances (e.g., honesty and loyalty). On the other hand, imperfect duties allow for discretion in their fulfillment (e.g., aiding others or pursuing self-improvement) (Hochberg, 1974; Rice et al., 2010). The distinction between these duties becomes especially pertinent in the high-pressure, tightly regulated world of aviation. Violations of either type of duty by pilots can have significant repercussions, not just regarding safety and compliance, but also how such behaviors affect the perceptions and trust among flight crews. These perceptions, in turn, play a critical role in shaping the professional and ethical culture within the aviation sector.

Dissecting the implications of Kant's ethical distinctions for pilot behavior, we focus on the violations of perfect and imperfect duties as they erode trust, diminish professional standards, and ultimately impact the safety and efficiency of flight operations (Rice et al., 2010). Through this exploration, we offer a perspective of the Kantian framework that assimilates high moral standards in a field that demands trust, leadership, and situational awareness. The ensuing discussion will not only highlight the direct impacts of ethical lapses on operational safety but also consider the subtler effects on crew dynamics, morale, and the overall professional ethos of the aviation industry.

Overview of Kant's Ethical Theory

The famed philosopher Immanuel Kant (1724-1804) espoused a systematic account of ethics that emphasized the role of duty and moral law (Johnson & Cureton, 2022; Kant, 2012). Central to his ethical theory is the distinction between perfect and imperfect duties, where perfect duties are those obligations that are generally universal and are binding for "rational beings" under all circumstances. These perfect duties are derived from the Categorical Imperative, which mandates that one must act only on the maxim they can consistently know to be a universal law without contradiction (Johnson & Cureton, 2022; Kant, 2012). So, for instance, the duty not to lie or to refrain from harming others is a perfect duty. The Categorical Imperative imposes these duties as morally binding in that even the slightest exception to their wants would lead to a logical contradiction and indicate a lapse of social competency.

On the other hand, imperfect duties are obligations that allow for some leeway in how they are to be fulfilled (Hochberg, 1974; Johnson & Cureton, 2022; Kant, 2012). The imperfect duties are also derived from the Categorical Imperative. However, they are more flexible in that they require individuals to pursue certain ends (happiness of others, self-improvement) without the ends specifying a given set of actions to be chosen at the moment. These imperfect duties are, therefore, sensitive to the variabilities of human circumstances or the need for practical judgment as to how they are to be applied to any given situation. They are morally binding as well, although they do not specify that only one course of action can fulfill the obligation but, instead, can fulfill its general dictates in a way that is proximate to the demands of the context and the capabilities of the agent (Igneski, 2006; Jing, 2013).

General Aviation Ethics

The principles and regulations governing pilot behavior and performance are deeply entrenched in a framework that mirrors Kantian's emphasis on duty, responsibility, and adherence to universal principles. Aviation ethics are embodied in a cosmopolitan of standards and regulations designed to ensure air travel's safety, security, and fairness (Stanford & Homan, 1999). The standards carefully constructed by international and national governing bodies outline the responsibilities and acceptable practices for flight crews and other professionals in the career field. They address the complexities of the aviation network, from technical competence and decision-making processes to communication and teamwork (Bigelow, 2018; Hoppe, 2018; Patankar, 1995).

Ethical standards in aviation are paramount in ensuring the safety and well-being of passengers, crew, and the public, akin to Kant's imperative for universal applicability. Trust, responsibility, and ethical behavior are the cornerstones of the aviation career field, reflecting a commitment to moral behavior at all levels of autonomy. Trust is critical as passengers and crew entrust their lives to pilots and crew daily (Li et al., 2021; Waymack, 2018b). Responsibility is definitive, as every decision and action could compromise safety. As a consequence of the aviation profession, ethical behavior comfortably provides a foundation for these two pillars to ensure that neither trust nor responsibility is misplaced (Hoppe, 2020).

Applying Kantian ethics to aviation underscores the importance of following one's duty and being guided by universal moral laws to demonstrate that one's actions are guided by the pursuit of safety, trust, and ethical responsibility (Chatzi et al., 2019; Waymack, 2018a). The congruence between the emphasis that Kant placed on moral duty and the ethical underpinnings that serve to guide aviation career professionals serves to underscore a shared commitment to acting in a principled manner designed to protect and serve the larger community. This symbiotic relationship between philosophical theory and pragmatic applications provides a robust backdrop to advance the aviation domain and foster a cultural paradigm for an evolving workforce.

Kant's Perfect Duties in Aviation

In aviation, applying Kant's concept of perfect duties offers a compelling framework for understanding the ethical obligations of aviation professionals. When viewed through the lens of aviation, these duties can be exemplified by the unwavering adherence to safety protocols and integrity when reporting maintenance issues (Patankar, 1995). Such actions are not merely recommended practices but are seen as moral imperatives that admit no exceptions.

The adherence to safety protocols in aviation can be directly linked to Kant's notion of perfect duties—actions that must always be performed, regardless of the circumstances. This includes the rigorous execution of pre-flight checks, strict compliance with air traffic control instructions, and the meticulous observation of maintenance schedules (Degani & Wiener, 1992; Shaukat et al., 2020). Each action embodies the Kantian imperative to act like one wishes it to become a universal law. In aviation, this means conducting oneself to ensure the utmost safety and well-being of all passengers and crew, aligning with the universal maxim of preserving life and promoting safety (Kant, 1925).

However, the ethical landscape of aviation has its challenges. Potential violations of these perfect duties (e.g., neglecting pre-flight checks or falsifying flight logs) are stark illustrations of ethical failings that can erode the foundational trust upon which the industry stands (Chen et al., 2011). These violations not only compromise the safety of the aircraft and all those aboard but also impact the broader perceptions of reliability and professionalism within the aviation community (Kania, 2018).

When a pilot or aviation technician decides to bypass a safety protocol or misreport maintenance issues, they exceed the moral detriment of social loathing and actively choose to deviate from a universal ethical principle. This decision puts lives at immediate risk and damages the fabric of trust that binds the aviation community (Kapur et al., 2016). This ethical dilemma may influence other flight crews to question their colleagues' reliability and the integrity of the systems in place to ensure their collective job safety (Chan & Li, 2022). This is particularly detrimental in an environment where the margin for error is exceedingly small and the consequences of failure exceptionally catastrophic.

The implications of neglecting these perfect duties extend beyond the immediate risks to safety and professionalism. They undermine the collective commitment to ethical standards essential for the aviation industry's network of performance. When flight crews observe or become aware of instances where their peers have failed to uphold these duties, it introduces uncertainty and vulnerability into an environment that relies heavily on predictability and trust. Such breaches of duty challenge the assumption that all aviation community members are committed to the highest standards of conduct, thereby putting additional strain on professional relationships and the overall ethos of the industry (Prinzel, 2002).

> *Examples*. In one hypothetical example, a student pilot is working to gain flight experience to begin a career as a professional pilot. During the years of obtaining this necessary experience, the pilot adds flights that did not occur to their logbook and purposefully overestimates flight length to record the minimum number of hours more quickly to meet airline hiring minimums.
>
> In another hypothetical example, a professional pilot chooses to violate company and FAA standards on the minimum time from consuming alcohol to beginning the flight. This decision results in the pilot reporting for duty being unfit for flight, putting fellow crewmembers and passengers at risk.

Violations of these duties, by contrast, not only jeopardize the immediate safety of passengers and crew but also inflict long-term damage on the industry's moral foundation. The commitment to these duties, therefore, is not just a matter of professional obligation but a moral imperative ensuring the integrity and sustainability of aviation.

Kant's Imperfect Duties in Aviation

In the nuanced realm of aviation, Kant's concept of imperfect duties takes on a unique and vital significance, reflecting obligations that are more flexible yet equally foundational to the ethical fabric of the industry. Within aviation, imperfect duties can be exemplified by the commitment to continuous professional development and the endeavor to foster a supportive team environment. Unlike perfect duties, which dictate actions that must always be performed, imperfect duties emphasize pursuing moral goals and improving oneself and one's community. These duties encourage aviation professionals to surpass the minimum requirements, promoting an ethos of excellence, cooperation, and mutual respect (Krivonos, 2007).

Continuous professional development in aviation is sustained by an ongoing commitment to enhancing and ensuring that pilots, engineers, and other aviation professionals remain at the forefront of best practices, technological advancements, and safety protocols (Bates & O'Brien, 2013). Regulations or protocols do not rigidly prescribe this pursuit; instead, it is motivated by a moral commitment to excellence and safety. Similarly, the effort to create and maintain a supportive team environment speaks to an imperfect duty to others. It fosters a culture of open communication, mutual respect, and collaboration—essential for effective teamwork and critical decision-making in high-pressure situations (Flin et al., 2002).

However, the violation of these imperfect duties, though more subtle in their immediate impact than the violation of perfect duties, can diminish cross-disciplinary skills, situational awareness, and an individual's ability to contribute effectively to team objectives and respond adeptly to emergent situations (Gaffney, 2015). This neglect undermines the individual's professional growth and burdens their colleagues, who may need to compensate for these deficiencies in critical moments (Valentine, 2018).

Poor communication and a failure to nurture a supportive team environment similarly harm team cohesion and morale (Kilner & Sheppard, 2010; O'Daniel & Rosenstein, 2008). In the high-stakes world of aviation, where decisions often need to be made quickly and collaboratively, communicating effectively and relying on one's colleagues is paramount. A team that lacks these qualities may find itself fragmented, with members working in isolation rather than in concert. This disunity not only deteriorates the team's operational effectiveness but also impacts the overall morale, leading to a work environment marked by frustration, misunderstanding, and lack of trust.

Examples. In one hypothetical example, an airline crew is on the final approach to landing in a major city. The aircraft is flying at a faster speed than it should be. Rather than abort the landing and try again as required by standard operating procedures, the crew continues the approach and salvages the landing safely.

> In another hypothetical example, the pilot of a small four-seat airplane is supposed to conduct a local sightseeing flight for two passengers; however, three passengers show up. The pilot recognizes that the unexpected passenger will make the aircraft exceed the maximum takeoff weight, but they conduct the flight anyway, believing the aircraft can fly safely overweight.

The implications of neglecting Kant's imperfect duties in aviation extend to include the ethos and culture of the aviation community, shaping perceptions of professionalism, reliability, and mutual respect. When aviation professionals consistently engage in continuous learning and foster a supportive team environment, they reinforce a culture of excellence and ethical integrity (Mintrom, 2014). Conversely, even if subtle, violations of these duties can gradually erode this culture, affecting not just individual teams but the industry.

Comparative Analysis of Perfect and Imperfect Duties in Aviation

Understanding the comparative effects of ethical violations provides insight into the dynamics within flight crews, which is pivotal to the safety and efficiency of aviation operations. Violating perfect duties, such as adhering strictly to safety protocols or reporting maintenance issues truthfully, has immediate and stark consequences for flight crew dynamics. Consider a hypothetical scenario where a pilot knowingly bypasses a crucial pre-flight check due to time pressure, prioritizing schedule adherence over safety. This action not only jeopardizes the safety of the flight but severely undermines the trust among crew members once discovered. Given its absolute and non-negotiable nature, the breach of a perfect duty is seen as a fundamental betrayal of the crew's collective commitment to safety. The impact on team dynamics is immediate and profound, with trust eroded and professional standards called into question. The knowledge that a crew member willingly compromised safety can lead to a pervasive sense of insecurity and doubt, impairing the team's ability to function cohesively (Palanski et al., 2011).

In contrast, while more subtle, the violation of imperfect duties negatively manipulates team cohesion and morale. Imagine a scenario where a flight crew member consistently needs to pay more attention to opportunities for professional development, gradually becoming less proficient with new navigation technologies. While this oversight may not immediately imperil the flight, it burdens fellow team members with the weight of compensating for another's deficiencies over time. Additionally, if a crew member fails to contribute to a supportive team environment by frequently engaging in poor communication, the cumulative effect can be a decline in team morale and effectiveness. While the violation of ethical framing is not overt, its insidious nature undermines the team's unity and operational efficiency over time (Valentine, 2018).

Illustrative real-world examples vividly underscore the divergence in consequences between violating perfect and imperfect duties. Incidents, where flight safety was compromised due to the deliberate falsification of maintenance records or the willful ignoring of safety protocols, highlight the catastrophic consequences of neglecting perfect duties. These cases often result in significant legal, professional, and reputational consequences for the individuals involved and can lead to a systemic overhaul of procedures and training within the affected organizations.

Conversely, case studies chronicling persistent issues such as deficient communication, mutual disrespect among crew members, or neglecting ongoing professional development may lack the sensationalism of singular, high-profile incidents. However, they contribute to a gradual decline in operational effectiveness, safety standards, and team morale. Over time, these issues manifest in a proliferation of minor incidents or near-misses, each signaling more profound systemic deficiencies within the team or organization (DiazGranados et al., 2023)

> *Case Study*. A flight instructor works at a flight school where they train several students working toward becoming professional pilots. On several occasions, the instructor is seen by students as taking shortcuts around flight school policies. The flight instructor skips essential steps during the pre-flight assessment, completes flights in lower-than-recommended weather conditions, and fails to properly review aircraft documentation before conducting flights. While the flight instructor always tells their students to adhere to all policies, they fail to lead by example, creating mixed messaging to students and encouraging them to behave similarly.

In summary, while breaching perfect duties in aviation yields immediate and severe consequences, the more nuanced neglect of imperfect duties can inflict equally significant harm on flight crew dynamics, safety, and professional norms. Both categories of duties are essential components of aviation's ethical and operational framework, emphasizing the necessity of adopting a comprehensive approach to ethics and professionalism within flight teams.

Broader Ethical Implications and the Role of Ethical Leadership

The ethical terrain of aviation, molded by the interplay of perfect and imperfect duties, initiates a broader dialogue on aviation safety, professionalism, and the inherent responsibility entrusted to those who manage and navigate the skies. The ramifications of adhering to or violating these duties extend to flight crews, touching on fundamental concerns about the trustworthiness of the aviation industry and its commitment to safeguarding human lives.

The violation of perfect duties, with their unequivocal mandates for safety and honesty, elicits acute ethical questions about the stability of aviation safety. When such duties are neglected, the breach is not merely procedural but moral, questioning the integrity of the systems and individuals within the industry. Negligence of imperfect duties overthrows professionalism and ethical conduct within the aviation community.

Ethical leadership is at the heart of addressing these ethical challenges. From senior pilots to airline executives, leaders within the aviation industry have a critical role in fostering a culture of integrity, responsibility, and continuous improvement (Demirtas, 2015). Ethical leaders are role models, demonstrating the importance of perfect and imperfect duties through their actions and decisions. They cultivate environments where safety and professionalism are paramount, honesty and integrity in reporting are the norm, and continuous professional development and mutual support are actively championed (Freiwald, 2013).

> *Example*. A management team at a charter flight operator is committed to enhancing the safety of their operation. To that end, they work across all employee divisions (pilots,

> flight attendants, technicians, and front office staff) to create a 'just culture' environment. Within this just culture framework, the organization demonstrates a commitment to continuous improvement and safety. Employees are encouraged, recognized, and rewarded for identifying safety issues rather than fearful of punishment or reprisal.

Such leadership proves indispensable in engendering a culture where ethical considerations permeate operational decisions, which are not solely dictated by legal statutes or organizational policies but are informed by a profound comprehension of moral obligation. Ethical leadership in aviation fosters an environment where every team member feels empowered and obligated to uphold the highest standards of safety and professionalism. It ensures that the industry responds reactively to ethical breaches while taking proactive strides to forestall them through education, policy initiatives, and a shared dedication to ethical excellence (Phillips, 2006).

Potential areas for future research

This exploration into Kantian ethics in aviation suggests several directions for future research, any of which are poised to extend our comprehension of ethical behavior in this critical domain. For example, empirical research into pilots' perceptions of ethical behavior holds the potential to unveil invaluable insights into the practical application of ethical theories in commercial aviation. Such investigations could unveil gaps in training protocols or mismatches between ethical principles and real-world exigencies. Surveys or interviews with pilots and other personnel could serve as vehicles for documenting their grasp of pertinent ethical principles and the extent to which these principles are used in daily activities. For example, one could explore how pilots perceive honesty as a value proposition when reporting technical issues amidst operational pressures to adhere to schedules.

In parallel, legislators and airline industry executives may also wish to develop ethical training programs tailored to flight crews. Additional future research may also explore the effectiveness of various ethical training modules designed to cultivate the making of effective decisions under duress. This line of inquiry might foreground Kant's inculcation of 'perfect' and 'imperfect' duties, for example—a longitudinal study following trainees for incident rates and protocol compliance over time.

Future research may also consider the role of regulators in policing aviation ethical standards. That is, through what policies and oversight mechanisms might the ethical integrity of aviation professionals best be maintained or still better furthered? This line of inquiry might offer case studies of statutory interventions that have improved ethical standards and safety outcomes within commercial airlines. Together, these areas of study promise to enrich the discourse on aviation ethics, offering pathways to enhance the moral integrity of the industry.

Conclusions

This examination of moral conduct in aviation, as analyzed through Immanuel Kant's perfect and imperfect duties, has carefully noted ethical constructs' profound implications for the aviation industry. The paper has underscored the importance of understanding and fostering ethical behavior in aviation by illustrating perfect and imperfect duties and their potential to threaten the aviation ecosystem. Through this analysis, the importance of ethical leadership in guiding pilots in developing an ethical aviator culture of integrity and accountability has been emphasized, offering the potential for courses that help navigate aviators through the intricate ethical terrain of aviation.

Looking forward, further efforts are needed to examine the real-world application of Kantian ethics in aviation, including empirical studies that assess how the behavior of pilots is commonly perceived. Such studies would shed additional light on how ethical conduct shapes team dynamics and operational safety. In addition, developing ethical training programs tailor-made for flight crews would help identify how ethical standards and practices might best be inculcated within the industry. In these endeavors lies a potential for elevating our commitment to upholding the highest moral precepts in the never-ending pursuit of aviation excellence.

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