Collegiate Aviation Review International

Volume 37 | Issue 2
Fall 2019

The Peer Reviewed Journal of the University Aviation Association

ISSN: 1523-5955

COLLEGIATE AVIATION REVIEW INTERNATIONAL

A PEER REVIEWED JOURNAL OF THE

UNIVERSITY AVIATION ASSOCIATION

COLLEGIATE AVIATION REVIEW INTERNATIONAL
2019 VOLUME 37 ISSUE 2
Ryan J. Wallace, Editor

ISSN: 1523-5955

Correspondence and inquiries:

University Aviation Association
2787 N. 2nd St
Memphis, TN 38127
(901) 563-0505
hello@uaa.aero

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

Thank you to all of the individuals who served as reviewers for the scholarly works published in this issue!

Michael Audino, *University of South Florida*
Timm Bliss, *Oklahoma State University*
Aliona Buresh, *Embry-Riddle Aeronautical University*
Gary Carter, *Embry-Riddle Aeronautical University*
Patti Clark, *Embry-Riddle Aeronautical University*
David Cross, *Embry-Riddle Aeronautical University*
Stephen Cusick, *Florida Institute of Technology*
James Holliman, *Embry-Riddle Aeronautical University*
Todd Hubbard, *University of Oklahoma*
William Huth, *University of West Florida*
Mary Johnson, *Purdue University*
Randy Johnson, *Utah Valley University*
Rian Mehta, *Florida Institute of Technology*
Myrna Olson, *University of North Dakota*
Alan Orr, *Embry-Riddle Aeronautical University*
Jennifer Roberts, *Embry-Riddle Aeronautical University*
Mike Robertson, *Southern Illinois University*
Gary Ullrich, *University of North Dakota*
Matt Vance, *Oklahoma State University*
Scott Winter, *Embry-Riddle Aeronautical University*

TABLE OF CONTENTS

Peer-Reviewed Articles

Literature Reviews

Collegiate Aviation Review International

Volume 37 | Issue 2 Peer-Reviewed Article #1

6-7-2019

Government Seat Pitch Regulation of Commercial Airlines: A Multi-Study of Consumer Perceptions

Scott R. Winter
Embry-Riddle Aeronautical University

Since deregulation of the airline industry in the 1970s, the distance between seats on commercial aircraft referred to as seat pitch has been decreasing. What used to be around 35 inches has now reduced to 28-31 inches depending on the type of airline and fare class purchased. As a result, some consumer advocacy groups have filed litigation and pressed the U.S. Congress to regulate a minimum seat pitch. These advocacy groups primarily cite safety concerns in the event of an emergency evacuation of the aircraft or health concerns such as deep vein thrombosis, which can occur from extended sitting periods and cramped quarters. Counter-arguments relate to consumers price sensitivity as it relates to airfare purchases, and their ability to purchase upgrades, such as seats with greater seat pitch, for additional fees. Therefore, the purpose of these studies was to identify consumer perceptions on government involvement in airline seat pitch and to create and validate a statistical model to predict a passenger's support of government regulation of seat pitch. The findings indicate that approximately 60% of passengers felt the government should regulate seat pitch. Perceptions of regulation value, disgust, happiness, Republican political affiliation, Hispanic ethnicity, Asian ethnicity, and high school level of education were significant predictors of support for government regulation of commercial airline seat pitch. The model explains 53.7% of the variance, and three separate, secondary assessments suggested good model fit and a valid model was produced. The practical applications of these findings are discussed.

Recommended Citation:
Winter, S.R. (2019). Government Seat Pitch Regulation of Commercial Airlines: A Multi-Study of Consumer Perceptions. *Collegiate Aviation Review International,* 37(2), 1-15. http://dx.doi.org/10.22488/okstate.19.100213

As airlines work to evaluate and develop their pricing models, a recent trend of the last three decades has been the decrease in seat pitch (Mendoza, 2017). Seat pitch is defined as the distance on one seat to the same point on the seat ahead of or behind it. During the 1970s, seat pitch ranged from 31 to 35 inches while today it has been reduced to 28 inches on some of America's low-cost carriers (Glusac, 2018). However, this condensing of seat pitch is not restricted to low-cost carriers. As the three remaining legacy carriers (American, Delta, and United) identify ways to compete with low-cost carrier offerings, American Airlines, in 2017, considered deploying a section of their aircraft which would have had seat pitch reduced from 31 inches to 28 inches (Silk, 2017), however, the airline subsequently retracted that proposal (Glusac, 2018). With reduced seat pitch comes a tradeoff of concerns for passengers.

Passengers are feeling more cramped and discomfort on flights. Meanwhile, airlines continue to evaluate ways to maximize profits, often through increasing seats on aircraft. However, the increased number of seats on aircraft have some advocates concerned about not just passenger comfort, but safety and health concerns related to the reduction in seat pitch. Concerns over safety, such as the regulatory requirement that commercial aircraft be completely evacuated in less than 90 seconds in an emergency or passenger health threats such as deep vein thrombosis (DVT) are cited arguments in favor of governmental regulation. Earlier studies have examined consumer's willingness to pay for upgrades on flights (Balcombe, Fraser, & Harris, 2009; Kuo & Jou, 2017; Lee & Luengo-Prado, 2004), such as premium economy offerings with more seat pitch, customer satisfaction (Koklic, Kukar-Kinney, & Vegelj, 2017), and passenger loyalty (Akamavi, Mohamed, Pellmann, & Xu, 2015). However, a gap in the literature has been identified in regard to evaluating passenger's perspectives on governmental regulation of seat pitch. Therefore, the purpose of these current studies is to 1) identify passenger perceptions on government regulation of seat pitch and 2) determine which factors help predict a passenger's support for or against government regulation of seat pitch on commercial airlines.

Types of Product Offerings for Commercial Airline Travel

The discussion on seat pitch, in part, relates to the types of product offerings available to the consumer, and it is worth distinguishing between these products. Airlines in the United States are typically classified into three offerings: full-service carriers (FSCs), low-cost carriers (LCCs), and ultra-low-cost carriers (ULCCs). FSC airlines in the United States, especially for the three legacy carriers, frequently have multiple product offerings aboard the same aircraft which typically result in three offerings: first/business class, premium economy, and economy. First/business class usually comes with a much higher fare but includes items such as a meal and complimentary alcoholic beverages. Premium economy is a newer offering made available in the economy section, and there remains a considerable amount of variance in this product's offering. At a minimum, it can be a seat with a few more inches of legroom, or it could be as extensive as including meal and beverage service. Most FSCs now all offer some form of premium economy service on their mainline aircraft (excluding perhaps regional feeder aircraft). The last section provided is the economy section. This section has relatively standard service with minimal seat pitch and usually only non-alcoholic beverage service and a snack, with larger meals for purchase.

The two other types of carriers which are not legacy carriers are low cost and ultra-low-cost carriers. On LCCs, there is typically only one class of cabin and all extras, except for beverages, are an additional charge (Kim & Lee, 2011). Meanwhile, ULCCs typically charge additional fees for all other features from selecting your seat before the flight to carry-on baggage charges to a glass of water. The logic of the ULCCs is that you only pay for what you, as the individual consumer, need to use during the flight. As a result of the increased competition in the marketplace between legacy, LCCs, and ULCCs, all airlines have needed to assess their product offerings (Koklic, Kukar-Kinney, & Vegelj, 2017), and this is

part of the reason for reduced seat pitch throughout the industry. This reduction in seat pitch and consideration of the low-cost carrier model is being considered for both short-haul and long-haul international flight operations (Daft & Albers, 2012; Francis, Dennis, Ison, & Humphreys, 2007; Pels, 2008; Wensveen & Leick, 2009).

Advocating for Governmental Regulation of Commercial Airline Seat Pitch

Passenger advocacy groups, such as FlyersRights.org, have been working through legal options to attempt and request the Federal Aviation Administration (FAA) regulate seat size on commercial aircraft (Glusac, 2018). On July 2, 2018, the FAA issued a letter stating that they are not responsible for regulating passenger comfort and thus not responsible for regulating seat size (FAA, 2018). These groups have also been advocating Congress issue legislation which would require the FAA to regulate seat size, although so far, these efforts have been unsuccessful.

Advocacy organizations are particularity concerned with safety issues of increasing the number of seats on commercial aircraft and passenger health concerns. In the event of an emergency, FAA regulations require commercial aircraft must be evacuated within 90 seconds or less. While the FAA addressed this in their decision letter against regulating seat pitch, critics suggest that the trials for which aircraft manufacturers conduct these tests fail to include all members of the population, such as the elderly. A recent study (Lijmbach, Miehlke, & Vink, 2014) evaluated the elderly's ability to in- and egress from commercial aircraft seats and found that they do take significantly more time than younger members of the population and also support themselves more through touching armrests and backrests.

Another concern for passengers is related to health concerns (Elliott, 2018). Medical issues, such as deep vein thrombosis, pulmonary embolism, and restricted mobility could all be detrimental issues of sitting in a cramped area for an extended period (Mendoza, 2017). However, these health concerns are also related to the length of the flight and resulting time spent in these limited spaces. Research conducted on the most favorable seat pitch for passenger overall well-being found that the optimal seat pitch was between 34-40 inches (Kremser, Guenzkofer, Sedlmeier, Sabbah, & Bengler, 2012).

Mendoza (2017) acknowledged the tradeoffs between health risks, price, and airline seat size regulation. His research indicated that airline pricing is highly driven by competition, and as a result, caused passengers to evaluate their health, safety, and comfort concerns. Of concerns with the regulation of seat pitch would be the resulting price increase of such an action, which passengers would have much less control over than their comfort levels on a commercial airline flight.

Perspectives Against Regulating Seat Pitch

The airline's standpoint toward seat pitch on commercial aircraft, at least as expressed by two current airline CEOs is simple: if you want more space, pay for it (McCartney, 2018). In a recent interview by the Wall Street Journal, the CEOs of American Airlines and Delta Airlines were interviewed regarding their strategies and perspectives on seat pitch. Their view is to try and diversify their product offerings to allow consumers to decide for themselves as to what features they are willing to tolerate or pay to upgrade. This strategy is seen as a way for FSCs to try and compete with the LCC and ULCC business models.

Findings from research studies in the last 15 years suggest that passengers may be willing to pay for the additional products and legroom they desire. When comparing two programs, Lee and Luengo-Prado (2004) found United had success when they implemented a premium economy section of seating, to which consumers could upgrade, compared to American Airline's strategy at the time, which was *more room throughout coach*. The findings suggested that consumer's saw value in both having the choice and

the enhanced product offerings given the additional fee. The multiple seating sections also allowed United to offer cheaper fares to leisure travelers, who may be more price sensitive, and market their premium economy offerings to business travelers who may be more willing to upgrade their fare class and seat. This concept was also supported by Balcombe, Fraser, and Harris (2009) who found that, at least in principle, consumers would be willing to pay for upgrades in service.

Further research within the last few years supports the initial indication of the late 2000s, and the data seems to suggest that passengers value having choices. Kuo and Jou (2017) identify that there is a large number of travelers who were not willing to pay for upgraded, premium economy service. However, they also acknowledged that the "price sensitive business traveler" and "comfort seeking leisure" passengers may be two specific demographics who would be willing to purchase upgrades (Kuo & Jou, 2017, p. 141). For passengers willing to upgrade, their findings indicated that passengers would be willing to pay between $138 for short flights, $309 for medium flights, and $545 for long flights. Kurtulmusoglu, Can, and Tolon (2016) identified a low-cost airline as the preferred airline in their sample of participants. Participants in their study indicated that their primary concerning factor was ticket cost, followed by punctuality, and ease of booking. Therefore, it is possible that these participants respond well to a low-cost model where the ticket prices are lower, with the ability to upgrade services if they desire. These studies tend to suggest that passengers, in general, see value in being able to purchase items unbundled, such as obtaining the lowest ticket cost, and then selecting upgraded features, if they so decide. Due to consumers' focus on price sensitivity, it is possible that government regulation of seat pitch, which would likely result in increased fares, may not be something that most consumers would support but would rather be in control of their purchasing choices and value assessment for ancillary revenue items.

Current Studies

As seat pitch on commercial aircraft decreases, concerns have been addressed as to whether or not the government should regulate this distance on commercial airlines. Advocates in favor cite safety and health concerns as justification primarily. Those against government involvement frequently address the complex nature of airline pricing and the offerings of seats with greater legroom as upselling items for passengers who are willing to pay for it. However, an existing gap in the literature exists as to what consumers think about government involvement in regulating seat pitch. Study 1 identifies consumer perceptions toward commercial airline seat pitch, while Study 2 investigates which types of factors would predict a passenger's support of government involvement in seat pitch regulation. Therefore, the purpose of these studies is to identify consumer perceptions toward government regulation of commercial airline seat pitch and to identify which factors would predict a passenger's support for or against government regulation of the same. Due to the exploratory nature of these studies, hypotheses were not produced.

Study 1 – Methods

Participants

One hundred and ninety-one (77 females) participants were recruited for this study. Participants reported an average age of 38.01 (*SD* = 14.48) years old, and the participants were recruited from Amazon's ® Mechanical Turk ® (MTurk). MTurk is an online population of worldwide participants who are willing to complete online human intelligence tasks (HITs) in exchange for a small amount of monetary compensation. Prior studies have demonstrated that data collected from MTurk is as valid as normal laboratory data (Buhrmester, Kwang, & Gosling, 2011; Germine et al., 2012; Rice, Winter, Doherty, & Milner, 2017). To participate in this study, participants needed to be at least 18 years old and have flown on a commercial airline within the previous 12 months. Additionally, the researcher specified MTurk participants needed to be from the United States, have completed at least 100 prior tasks successfully on MTurk, and had a cumulative HIT approval rating of 90 or higher. MTurk allows

researchers to set minimum participant criterion to help ensure quality data. The HIT approval rating of 90 or higher and the completion of 100 prior tasks were purposefully established to avoid any negative influences that could exist through using online platforms, such as MTurk, for data collection. No anomalies were found in the initial data analysis.

Materials and Stimuli

Participants were first provided with an electronic consent form which they signed digitally indicating that they were over 18 years old. They also stated that they had flown commercially within the preceding 12 months to be eligible for the study. Following this, they were presented with the following information regarding commercial airline seat pitch:

> Seat pitch refers to the space between a point on one seat and the same point on the seat in front of it. For many carriers, the pitch in Economy class is 29 to 32 inches (74 to 81 cm). More seat pitch can mean more legroom, but legroom is also affected by the thickness of the seat back. Airlines have claimed that a reduction of seat pitch can be compensated for by a thinner seat-back design. (https://en.wikipedia.org/wiki/Airline_seat).

Following this description, participants were asked questions to rate their approval of government regulation of commercial seat pitch using a Likert-type rating system, with a neutral option of zero. Participants answered questions related to how strongly they felt toward or against government regulation, their optimal seat pitch distance, and whether or not airlines should be allowed to keep existing seat pitch distances if the government regulated a higher standard. Next, they were asked a series of questions to measure their affect toward the government regulation of seat pitch. Following this, participants were asked a series of demographic questions such as gender, the frequency of travel, political affiliation, height, weight, age, and education level. Lastly, participants were provided with some open-ended questions to gather their perceptions of the advantages and disadvantages of government regulation of commercial airline seat pitch. At the conclusion of the study, participants were debriefed, compensated, and dismissed.

Design and Ethics

The study used a non-experimental design and descriptive statistical analysis to provide data on passenger perceptions toward seat pitch on commercial airliners. The Institutional Review Board (IRB) of the subject university reviewed the study and all associated materials before any data was collected. Additionally, the researcher held a current Collaborative Institutional Training Initiative (CITI) certificate on research with human participants.

Study 1 – Results

The findings from Study 1 provide descriptive data on passenger's perceptions toward government regulation of commercial airline seat pitch. Overall, approximately 60% of passengers agreed or strongly agreed that the government should regulate seat pitch on commercial airliners, while just under 24% disagreed or strongly disagreed and approximately 17% responded as neutral. The findings are presented in Figure 1.

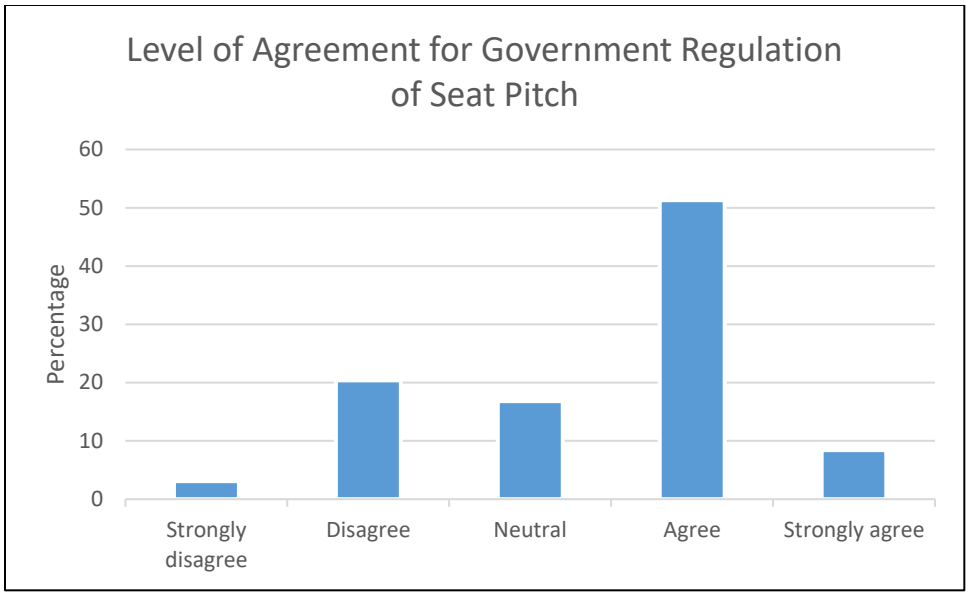


Figure 1. Passenger's level of agreement toward government regulation of commercial airline seat pitch.

Participants were also asked to rate on a spectrum from 27 inches to 32 inches, with an option of None, as to where they felt the government should set the minimum for commercial airline seat pitch. Figure 2 presents the findings, and the data suggests that most passengers felt the minimum should be around 30 to 31 inches.

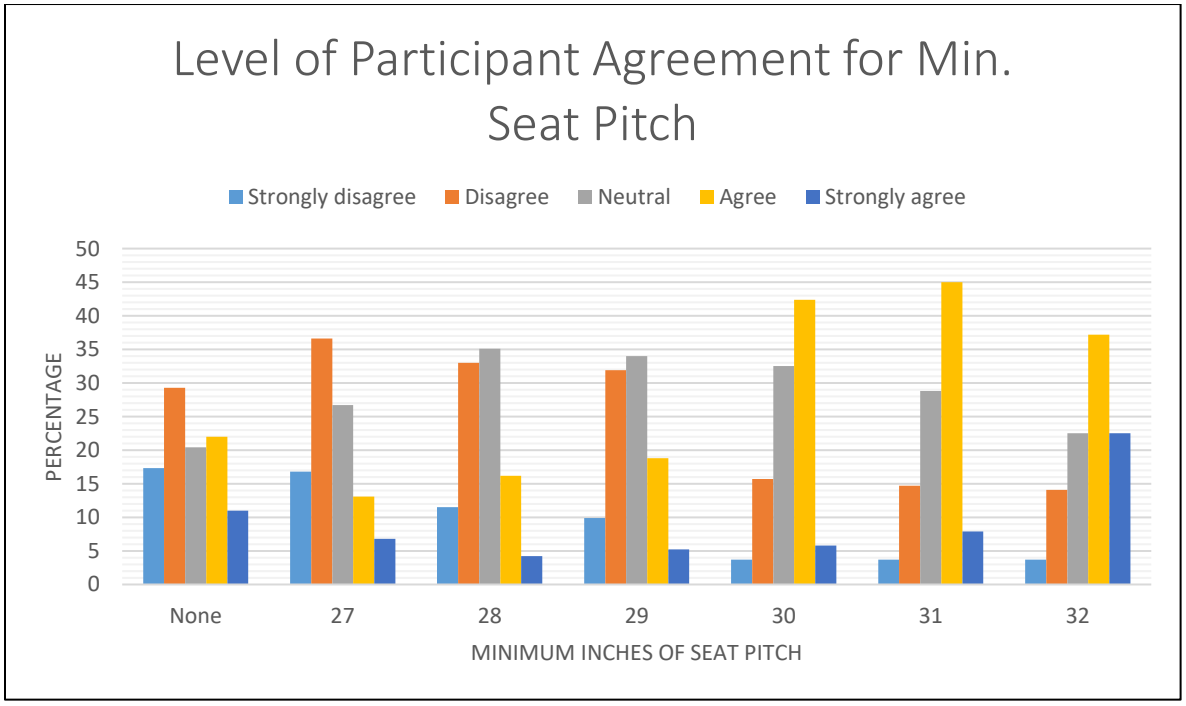


Figure 2. Participant ratings for their level of agreement with what distance of seat pitch minimum should be set by the government.

Passengers were also asked if the government were to set a minimum, which was a greater distance than airlines currently had installed on their aircraft, should the airlines be able to maintain their existing seat pitch or be required to increase it. Approximately 65% of passengers said airlines should be required to increase the seat pitch to the newly regulated minimum while only 38% felt airlines should be allowed to maintain existing seat pitch. These findings are highlighted in Figure 3.

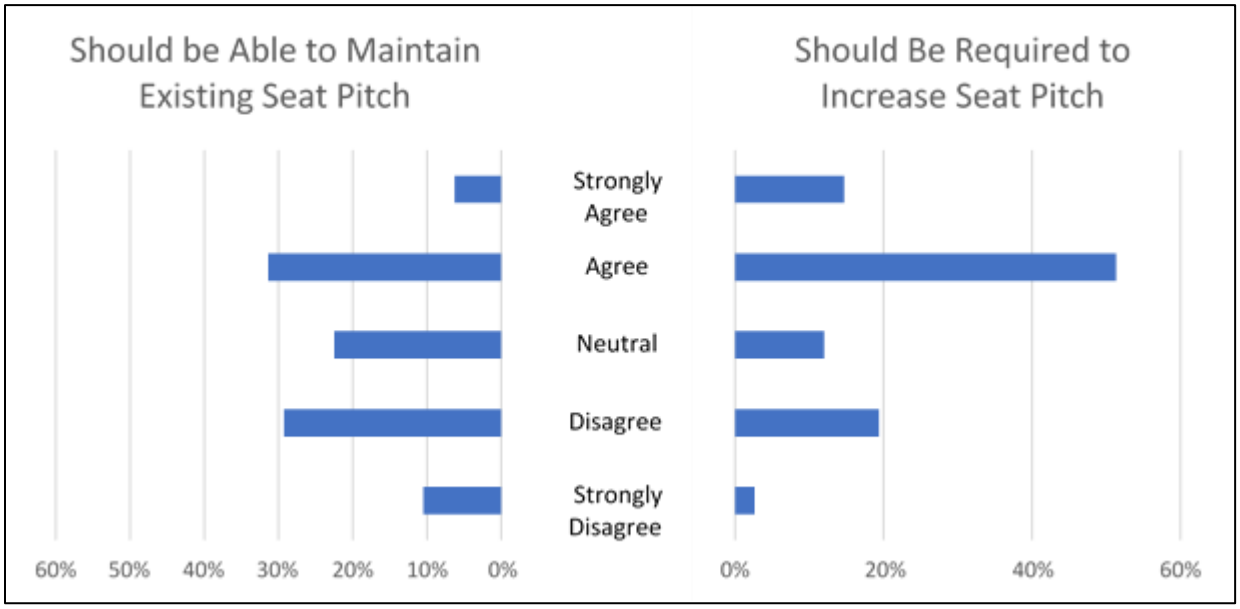


Figure 3. Participant responses on whether airlines should be able to maintain existing seat pitch or should be required to increase seat pitch if the government would regulate a minimum which is higher than currently installed on their aircraft.

The final quantitative results examined for any significant relationships between height, weight, and income on support of government regulation support. A Spearman's correlation found no significant relationships between height, $r_s(189) = .055$, $p = .446$, weight, $r_s(189) = -.097$, $p = .184$, income, $r_s(188) = -.030$, $p = .686$, and support of government regulation.

Lastly, a review was completed of open-ended responses provided by participants as to the advantages and disadvantages of government regulation of commercial airline seat pitch. Common answers in favor of government regulation were more comfort (additional legroom), increased safety, and better government oversight. The most commonly stated disadvantage was concern over ticket costs and increased airfares as a result of government intervention. The answers to opened-ended questions roughly matched the distribution of the quantitative question regarding support of government regulation of seat pitch as numerous participants also expressed their views that the government should not get involved or set a regulatory minimum.

Study 1 – Discussion

The findings from study 1 provide both quantitative and qualitative insights into passengers' perceptions on whether the government should regulate seat pitch on commercial airliners. Approximately 60% of passengers agreed or strongly agreed with government regulatory intervention for commercial airline seat pitch. However, this number is not as high as may have been expected, and it highlights that while a majority of passengers favor regulated seat pitch, there is still a group of passengers who are either neutral or against government involvement. In qualitative responses,

participants indicated that while they felt comfort and safety would be two main advantages of the government regulating commercial airline seat pitch, the major disadvantage was their concern that these regulations would result in higher ticket prices and airfares.

Study 2 – Introduction

In Study 1, participants provided both quantitative and qualitative responses regarding their support for or against government regulation of commercial airline seat pitch. Given that not all passengers were in favor of government regulation, the purpose of Study 2 was to develop a valid model to identify factors that predict a passenger's support of government regulation of commercial airline seat pitch. Study 2 was conducted in two stages, first to develop a regression model and second to validate the model.

Study 2 - Methods – Stage 1

Participants

Two hundred and twenty-three (91 females) participants were used in the development of the regression equation in Stage 1. Participants reported an average age of 34.97 (*SD* = 10.04) years old, and the participants were recruited from Amazon's ® Mechanical Turk ® (MTurk) using the same worker requirements as in Study 1.

Materials and Stimuli

Participants were first provided with an electronic consent form that they digitally acknowledged to participate in the study. After verifying they were at least 18 years old, they were presented with instructions and the following information regarding commercial airline seat pitch:

> Seat pitch refers to the space between a point on one seat and the same point on the seat in front of it. For many carriers, the pitch in Economy class is 29 to 32 inches (74 to 81 cm). More seat pitch can mean more legroom, but legroom is also affected by the thickness of the seat back. Airlines have claimed that a reduction of seat pitch can be compensated for by a thinner seat-back design. (https://en.wikipedia.org/wiki/Airline_seat).

Following this description, participants were given the following statement: *"Imagine a situation where the government is planning to regulate seat pitch on commercial aircraft."* Participants were then asked to complete three scales relating to their perceptions on the familiarity, complexity, and value of government regulation of seat pitch. Next participants provided their ratings of comfort, safety, and ticket cost, and they were provided a 10-point rating scale that ranges from (1) *"I am NOT concerned with comfort/safety/ticket cost* to (10) *"I AM concerned with comfort/safety/ticket cost"* . Following this, participants responded to affect questions using the six universal facial expressions from Ekman and Friesen (1971). The images can be found in Figure 4, and the 10-point rating scale ranged from (1) "*I do not feel this way at all"* to (10) *"Extremely feel this way"*. Participants then rated how strongly they felt the government should or should not regulate airline seat pitch using the statements "*The government should NOT regulate airline seat pitch"* (1) to *"The government SHOULD regulate airline seat pitch"* (10). Participants were then asked demographic questions related to their gender, age, ethnicity, the frequency of paying for airline seat upgrades, political affiliation, the highest level of education, number of roundtrip airline flights per year, and annual income. Lastly, participants were debriefed, compensated, and dismissed.

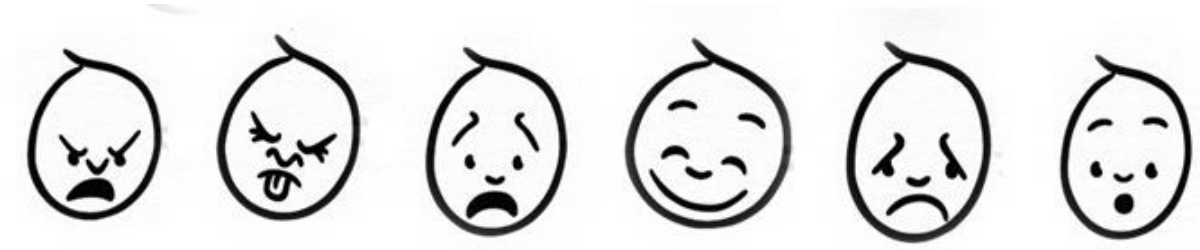


Figure 4. The six facial expressions of Ekman and Friesen (1971). The images represented, from left to right, are anger, disgust, fear, happiness, sadness, and surprise.

Design and Ethics

This study used a quantitative non-experimental design to identify which factors predict a participant's support of government seat pitch regulation. As in Study 1, the IRB of the subject university reviewed the study and all associated materials before any data was collected.

Study 2 - Results – Stage 1

The purpose of Stage 1 was to develop a regression equation that would predict a participant's support of government regulation of commercial airline seat pitch. The study used 20 possible predictors:

- regulation complexity, regulation familiarity, regulation value, comfort, safety, ticket cost;
- six universal facial expressions of anger, disgust, fear, happiness, sadness, and surprise;
- gender, ethnicity, number of roundtrip flights per year, percentage of flight completed with a paid seat upgrade, age, highest level of education, annual income, and political affiliation.

G*Power software was used to determine the necessary sample size for each stage. Using an alpha level of .05, power .95, and 20 predictors a required sample size of 222 participants were needed.

Initial Data Analysis

The data was assessed to verify the assumptions of regression were completed. Independence of residuals was examined using the Durban-Watson statistic yielding a value of 2.273. Since the value is close to 2, the data can be assumed not to violate the independence of residuals. All leverage values were determined to be less than .2, indicating that no cases had excessive leverage on the model, and all Cook's distances were above 1. Thus there were no influential cases within the data. A check of Mahalanobis' distance values demonstrated that all observed values were less than the critical value of 45.31 (highest observed 34.73) which indicates there were no outliers in the data. Tolerance values were all above .1 suggesting there were no issues with multicollinearity in the model. Finally, normality and homoscedasticity were assumed as met through an assessment of a residual histogram plot, P-P plots, and standardized residual vs. standardized predicted value plots.

Regression Equation Development

A backward stepwise regression was completed using 223 participants recruited via Amazon's Mechanical Turk to eliminate statistically insignificant predictors. The results produced a model with seven significant predictors of support for government regulation of commercial airline seat pitch: regulation value, disgust, happiness, Republican affiliation, Hispanic ethnicity, Asian ethnicity, and high school level of education. The resulting regression equation produced was:

$$Y = 4.954 + 1.499X_1 - 0.095X_2 + 0.250X_3 - 0.417X_4 - 1.571X_5 - 0.916X_6 - 0.572X_7$$

Where Y is the predicted support of government regulation of commercial airline seat pitch, and regulation value (X_1), disgust (X_2), happiness (X_3), Republication affiliation (X_4), Hispanic ethnicity (X_5), Asian ethnicity (X_6), and high school level of education (X_7). These predictors suggest that participants who found *greater value* in government regulation and who expressed *happiness toward government regulation* were *more supportive* of the government regulating commercial airline seat pitch. Participants who were *disgusted* by government regulation, Republication affiliation, Hispanic ethnicity, Asian ethnicity, and high school level of education were *less supportive* of government regulation of commercial airline seat pitch. The model accounted for 53.7% (52.2% adjusted) of the variance in the dependent variable, and it was significant, $F(7, 222) = 35.64$, $p < 0.001$.

Study 2 - Methods – Stage 2

Participants

An independent sample of 247 (112 female) participants was used to examine the model fit in stage 2. The average age of participants was 35.23 ($SD = 11.40$) years old. All participants were recruited from MTurk using the same selection parameters as described in Stage 1.

Materials and Stimuli

Participants completed the same instrument and followed the same procedure as in stage 1.

Design

Stage 2 also used a quantitative non-experimental design to identify which factors predict a participant's support of government seat pitch regulation and conduct a model fit assessment of the regression equation developed in Stage 1.

Study 2 - Results – Stage 2

Stage 2 – Model Fit

The regression equation developed in Stage 1 was tested for model fit and validity in stage 2 using an independent sample of 247 participants from MTurk. Model fit and validity was examined using three analyzes. First, a *t*-test was completed between the predicted score for government regulation of seat pitch with the actual score of participants. Second, a Pearson's correlation was conducted between the predicted and actual values, and finally, the cross-validated R^2 was calculated.

Model fit was first examined by using a *t*-test of the predicted government regulation of seat pitch scores and the actual scores reported in Stage 2. The regression equation developed in stage 1 was used to calculate the predicted value of the Stage 2 data. An independent samples *t*-test found no significant difference between the predicted stage 2 scores ($M = 6.72$, $SD = 1.58$) and the actual Stage 2 scores ($M = 6.60$, $SD = 2.50$), $t(492) = .787$, $p = .431$. Since the predicted scores of government regulation of seat pitch do not significantly differ from the actual scores, this suggests the original regression equation is a valid model to predict government support of regulating seat pitch.

Next, a Pearson's correlation was conducted between the predicted government regulation of seat pitch score and the actual score from Stage 2. The data suggest a statistically significant relationship

exists, $r(245) = .541$, $p < .001$. This cross-validity correlation coefficient suggests further evidence of model fit.

Last, the model fit was examined using the cross-validated R^2. Cross-validated $R'^2 = 1 - (1 - R^2)[(n + k) / (n - k)]$, where R^2 is the overall R^2 from the Stage 1 model, n is the sample size of the stage 1 sample, and k is the degrees of freedom. The calculation revealed $R'^2 = .509$, and this indicates how well the preliminary model would apply to other samples from the population. Due to the low difference between the overall R^2 and the cross-validated R'^2, the presence of model fit can be suggested. The model fit summaries are presented in Table 1.

Table 1

Model Fit using Actual Vs Predicted Scores for Study 2 Stage 2

t-Test			Correlation		Cross-Validated R^2
t	df	Sig.	*r*	Sig.	
0.787	492	.431	.541	<.001	.509

Study 2 – Discussion

Study 2 created and validated a statistical model to predict a passenger's likelihood to support government regulation of seat pitch. Seven factors were found to be significant: regulation value, disgust, happiness, Republican affiliation, Hispanic ethnicity, Asian ethnicity, and high school level of education. These factors provide some insight into the types of individuals who may or may not favor government regulatory involvement in commercial airline seat pitch.

General Discussion

The findings from these two studies provide some insight into passengers' feelings on government regulation of seat pitch. The results from Study 1 indicate that while approximately 60% of passengers agreed or strongly agreed with government regulation of seat pitch, there were also participants who felt strongly against government involvement. Study 2 provided insights into the factors which would predict a passenger's likelihood of supporting government regulation of commercial airline seat pitch.

The main advantage highlighted by participants in support of government regulation was the increased comfort that would result from having an increased seat pitch. Participants indicated that their ideal value was around 30-31 inches, and approximately 65% felt airlines should be forced to increase the seat pitch of their aircraft if the government imposed a minimum that was greater than that currently installed on aircraft. This value indicated by participants was still less than the ideal amount of seat pitch for overall passenger health of 34-40 inches (Kremser et al., 2012). Along with comfort comes safety and health concerns, which are the leading arguments in favor of government intervention (Elliott, 2018; Glusac, 2018), especially with reduced seat pitch being considered in both the short- and long-haul markets (Daft & Albers, 2012; Francis, Dennis, Ison, & Humphreys, 2007; Pels, 2008; Wensveen & Leick, 2009).

The main disadvantage attributed to government involvement is the possible resulting airfare increase, which was a commonly cited concern in the open-ended responses of participants from study 1. The airlines suggest government regulation would result in increased airfares, and participants also

expressed this concern. Airlines highlight reductions in seat pitch as necessary to compete with low-cost and ultra-low-cost carriers, and they say they provide products with greater seat pitch for customers who are willing to pay (McCartney, 2018). Lee and Luengo-Prado (2004) found that airlines which offered a premium economy upgrade section were more profitable than an airline that offered greater seat pitch throughout the entire cabin. It may be possible that consumers, at least the ones opposed to government regulation, are willing to accept reduced seat pitch to secure the lowest ticket cost. Kurtulmusoglu, Can, and Tolon (2016) found that in their sample, ticket cost was the primary concern of participants. For those passengers who are against government regulation, it is possible that they most value low ticket costs and prefer to have the choice to purchase upgrades if they desire. This finding was supported in prior research by Kuo and Jou (2017) who found that while most passengers were unwilling to pay for upgrades, the *price-sensitive business traveler* and *comfort seeking leisure* passengers may be a target audience for these upsell products.

The statistical model revealed some further insights into the types of factors that predict a passenger's level of support for government regulation of seat pitch. As the perception of regulatory value and happiness toward government regulation increases, so does support of government regulation. For these individuals, it is possible that they view the regulation to be a benefit to passengers and thus are more supportive of it. However, individuals who felt disgusted by the government regulatory involvement were less likely to support the regulation of seat pitch, and those participants who identified as Republican, Hispanic, Asian, and who had a high school level of education were generally more opposed to government regulation. It is possible that these individuals prefer the ability to make their own choices when it comes to the type of seat pitch they are willing to accept for the amount they have to pay. While consumers have been shown in principle to be willing to pay more to upgrade (Balcombe, Fraser, & Harris, 2009), most do not purchase upgrades to sections such as premium economy (Kuo & Jou, 2017). It is possible that some passengers recognize the tradeoffs between comfort and cost, and they have indicated that they would instead make these decisions for themselves instead of having a regulated minimum.

Practical Applications and Future Research Recommendations

The findings from the study offer some practical applications and recommendations for future research. The main issues seem to concern ticket cost, safety, and health concerns. First, while a majority of participants favor government regulation of seat pitch, it is not an overwhelming majority, which identifies some mixed perspectives on this issue. Passengers identified one of their main concerns as ticket cost, and further research should investigate anticipated increases in airfare, if any, which would be the result from a minimum seat pitch being established. Second, concerns identified over safety and the ability to evacuate the aircraft in the required minimum amount of time should be further researched to ensure aircraft can safely and efficiently be evacuated with current and proposed seat pitch distanced. Lastly, concerns over passenger health along with health concerns for flights over longer periods in seats with reduced pitch should be addressed. These health issues are primarily of concern on long-haul flights with reduced seat pitch, and health-related significant problems may be of interest to passengers and the government. Additional data from the investigation of these three areas may help provide further and valuable information which could help inform passengers and the government as to whether regulation of seat pitch is necessary.

Limitations

A few limitations bound the current studies. First, the studies used participants from Amazon's Mechanical Turk. While this population has been shown to be as valid as traditional laboratory data (Buhrmester, Kwang, & Gosling, 2011; Germine, et al., 2012; Rice et al., 2017), the results cannot be generalized beyond those types of individuals who completed online human intelligence tasks for

monetary compensation. Second, participants were presented with hypothetical scenarios in both studies. Participant behavior may be different from their attitudes or in a dynamic environment, such as one where they have to purchase a ticket, and the ticket cost is changing as a result of any regulatory effect. The studies were also limited to how much information to provide or not provide to participants. It is possible that providing this information to participants before the study may have influenced some of their responses (Furnham & Boo, 2011; Green, Jacowitz, Kahneman, McFadden, 1998). Neutral descriptions of seat pitch were presented to try and prevent biasing the participant's perspectives and to compliment this limitation. A participant eligibility requirement was to have completed a commercial airline flight within the preceding 12 months so that participants would have recently experienced a flight and be able to reflect on their experience accurately.

Conclusions

A current issue within the aviation industry is whether seat pitch should remain determined by the airlines or if the government should set a regulatory minimum. Passenger groups and airlines have offered differing views on the issue with a focus on ticket cost, safety, and passenger health concerns. This study provides an analysis of passenger perceptions, and the findings indicate that approximately 60% of passenger agree or strongly agree with the government regulating commercial airline seat pitch. Furthermore, 65% felt airlines should be required to increase the seat pitch on their aircraft if the regulated minimum was higher than their current seating configuration. The study also produced a valid model to help predict a person’s likelihood to support government regulation of seat pitch. Rating of regulation value, disgust, happiness, Republican affiliation, Hispanic ethnicity, Asian ethnicity, and high school level of education were all significant predictors in the model.

References

Akamavi, R. K., Mohamed, E., Pellmann, K., & Xu, Y. (2015). Key determinants of passenger loyalty in the low-cost airline business. *Tourism Management, 46,* 528-545.

Balcombe, K., Fraser, I., & Harris, L. (2009). Consumer willingness to pay for in-flight service and comfort levels: A choice experiment. *Journal of Air Transport Management, 15,* 221-226.

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk: A new source of inexpensive, yet high-quality data? Perspectives on Psychological Science, 6(3), 3-5.

Daft, J. & Albers, S. (2012). A profitability analysis of low-cost long-haul flight operations. *Journal of Air Transport Management, 19,* 49-54.

Ekman, P. & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology*, *17*(2), 124-129.

Elliott, C. (2018, July 15). Airline seat standard coming, as safety concerns, passenger complaints mount. *USA Today*. Retrieved from: https://www.usatoday.com/story/travel/advice/2018/07/15/airline-seat-standards-government-regulations-coming/777040002/

FAA. (2018, July 2). [Letter to Paul Hudson]. Retrieved from http://files.constantcontact.com/7a85813b001/d1d4f4f1-9864-46a2-a056-69180fe2f2ed.pdf

Francis, G., Dennis, N., Ison, S., & Humphreys, I. (2007). The transferability of the low-cost model to long-haul airline operations. *Tourism Management, 28,* 391-398.

Furnham, A. & Boo, H. C. (2011). A literature review of the anchoring effect. *The Journal of Socio-Economoics, 40,* 35-42.

Germine, L., Nakayama, K., Duchaine, B.C., Chabris, C.F., Chatterjee, G., & Wilmer, J.B. (2012) Is the web as good as the lab? Comparable performance from web and lab in cognitive/perceptual experiments. Psychonomic Bulletin & Review, 19(5), 847-857.

Glusac, E. (2018, July 6). F.A.A. declines to regulate airplane seat size. *The New York Times*. Retrieved from: https://www.nytimes.com/2018/07/06/travel/faa-plane-seat-size.html

Green, D., Jacowitz, K. E., Kahneman, D., & McFadden, D. (1998). Referendum contingent valuation, anchoring, and willingness to pay for public goods. *Resource and Energy Economics, 20,* 85-116.

Lee, D. & Luengo-Prado, M. J. (2004). Are passengers willing to pay more for additional legroom? *Journal of Air Transport Management, 10,* 377-383.

Lijmback, W., Miehlke, P., & Vink, P. (2014, October). *Aircraft seat in- and egress differences between elderly and young adults.* Proceedings of the 58th Annual Meeting of the Human Factors and Ergonomics Society, Chicago, Illinois.

Kim, Y. K. & Lee, H. R. (2011). Customer satisfaction using low cost carriers. *Tourism Management, 32,* 235-243.

Koklic, M. K., Kukar-Kinney, M., & Vegelj, S. (2017). An investigation of consumer satisfaction with low-cost and full-service airline companies. *Journal of Business Research, 80,* 188-196.

Kremser, F., Guenzkofer, F., Sedlmeier, C., Sabbah, O., & Bengler, K. (2012). Aircraft seating comfort: The influence of seat pitch on passengers' well-being. *Work, 41,* 4936-4942.

Kuo, C. & Jou, R. (2017). Willingness to pay for airlines premium economy class: The perspective of passengers. *Journal of Air Transport Management, 59,* 134-142.

Kurtulmusoglu, F. B., Can, G. F., & Tolon, M. (2016). A voice in the skies: Listening to airline passenger preferences. *Journal of Air Transport Management, 57,* 130-137.

McCartney, S. (2018, July 24). When airline CEOs try the cheap seats. *The Wall Street Journal*. Retrieved from: https://www.wsj.com/articles/when-airline-ceos-try-the-cheap-seats-1532441990

Mendoza, R. L. (2017). Health risk, price efficiency, and airline seat size regulation. *International Journal of Healthcare Management, 11*(2), 122-132.

Mikulic & Prebezac, D. (2011). What drive passenger loyalty to traditional and low-cost airlines? A formative partial least squares approach. *Journal of Air Transport Management, 17,* 237-240.

Pels, E. (2008). Airline network competition: Full-service airlines, low-cost airlines, and long-haul markets. *Research in Transportation Economics, 24,* 68-74.

Rice, S., Winter, S.R., Doherty, S. & Milner, M.N. (2017). Advantages and disadvantages of using internet-based survey methods in aviation-related research. Journal of Aviation Technology and Engineering, 7(1), 58-65.

Silk, R. (2017, August 28). Regulating size of airline seats gaining support. *Travel Weekly.* Retrieved from: Regulating size of airline seats gaining support. *Travel Weekly*

Wensveen, J. G. & Leick, R. (2009). The long-haul low-cost carrier: A unique business model. *Journal of Air Transport Management, 15,* 127-133.

Collegiate Aviation Review International

Volume 37 | Issue 2 Peer-Reviewed Article #2

6-7-2019

The Effect of Electronic Flight Bags in Flight Training on Preflight Skill Development and Aeronautical Decision Making

Shlok Misra
Embry-Riddle Aeronautical University

Michele Halleran
Embry-Riddle Aeronautical University

This study was designed to evaluate the effects of utilizing Electronic Flight Bags (EFBs) in flight training with emphasis on preflight skill development and Aeronautical Decision Making. The study participants were student pilots or private pilots who used EFBs in flight training and had not logged more than 100 total flight hours. The study utilized a simulation of the preflight process of a Visual Flight Rules cross-country flight in which the participants answered questions related to the flight preparation. Fifty percent of the study's population completed this survey with the information provided through an EFB and the other 50% sample had to answer the questions without an EFB using traditional unabridged raw data. A comparative analysis of the data collected from both groups was performed. The largest degradation of performance was noted in Notices to Airmen (NOTAM) interpretation and the least degradation in performance was noted in weather-related decision-making.

Recommended Citation:
Misra, S. & Halleran, M. (2019). The Effect of Electronic Flight Bags in Flight Training on Preflight Skill Development and Aeronautical Decision Making. *Collegiate Aviation Review International,* 37(2), 16-37. http://dx.doi.org/10.22488/okstate.19.100214

It is well known that most accidents in flight are initiated from a chain of events that originate from poor preflight preparation. Therefore, the Federal Aviation Administration (FAA) has placed considerable emphasis on the preflight portion of a flight. This is reflected in the pilot training curriculum and in Advisory Circular (AC) 60-22, which contains a detailed discussion on the "Poor Judgment Chain" (FAA, 1991). The introduction of Electronic Flight Bags (EFBs) has been readily accepted by pilots as a means to decrease workload and increase pilot efficiency.

Purpose

The purpose of this study was to investigate the impact of utilizing electronic flight bags in a flight training environment on preflight planning techniques, skill development, and Aeronautical Decision Making (ADM) of ab-initio pilots. Electronic Flight Bags are widely used by ab-initio pilots in the modern flight training environment. This study was initiated while considering the importance of meticulous preflight preparation and briefings for pilots and the impact EFBs have on modern ab-initio pilots. It is important to study the relationship between the usage of EFBs by ab-initio pilots, the impact of that usage on their preflight skill development, and their development of ADM skills. This study aims to address skill degradation in flight planning without the help of an EFB for pilots that started using EFBs very early in their flying career.

Research Questions

1. How has the introduction of EFBs in flight training curriculum impacted the knowledge of interpreting raw aviation data (such as Notices to Airmen, METARs, and Charts Supplements)?
2. Can ab-initio pilots display comparable levels of decision making when they do not possess an EFB to plan a flight and make decisions based on raw aviation products (unanalyzed and unprocessed data)?

Literature Review

The FAA issues guidelines for the use of EFBs to 14 CFR Part 91 operators in AC 91-78. This AC defines EFBs as an electronic display system intended for flight deck or cabin use. An EFB device can boost pilot performance by digitally displaying a variety of aviation data such as checklists, navigation charts, and the pilot's operating handbook (POH). EFBs even perform basic calculations in flight such as aircraft performance, load, and fuel calculations (FAA, 2007). Electronic Flight Bags are used in the flight training environment from a student pilot's first flight as well as by commercial airline pilots throughout their careers.

While the introduction of EFBs in flight training can be seen as a positive step to develop technologically-enabled and resourceful pilots, it is important to successfully carry out long-term

risk analyses. Complacency and over-reliance have been rising issues with pilots using EFBs which give way to *automation dependency* that ultimately results in loss of *situation awareness* and *task saturation* when not using EFBs (Chandra, Yeh, Riley, & Mangold, 2003). Ab-initio pilots are also at risk of skill degradation due to excessive use of EFBs and not using raw products for decision making (Waldock, 2017). Skill degradation is the "loss or decay of trained or acquired skills (or knowledge) after periods of non-use" (Winfred, Bennett, Stanush, & McNelley, 1998, p. 58).

The FAA Human Factors Division studied the effects of EFBs on safety in flight in a 2014 report. This report included 276 voluntary safety reports from commercial operators in the United States. It was intended to study the impact of EFBs on flight safety, however, the report raised concerns including: lack of training or insufficient EFB training at air carriers, potential of distraction related to EFBs, storage of the EFB when not in use, and backup chart considerations (Chase & Hiltunen, 2014). Even though the safety reports were compiled from commercial airline operators, the implications also hold true for flight training.

The importance of such assessments stem from previous studies that studied the impact automation had on skill degradation and automation dependency. Winter et al. (2017) studied the performance of 29 pilots who held at least a private pilot certificate with an instrument rating. The study aimed to study pilot performance when using paper and electronic instrument approach charts. The performance of the pilots was significantly reduced when asked to complete tasks in instrument meteorological conditions without EFBs in a Flight Training Device (FTD) when compared to completed tasks with the help of EFBs. Not only did the researchers observe loss of control of the airplane when the pilots were not using an EFB, but also that pilots "felt the use of electronic charts reduced their workload as measured by the NASA Task Load Index (TLX)" (Winter et al., 2017, p.1).

Preflight Preparation

There has been a significant shift in the methodology used for preflight planning for flights. Significant technological advancements have changed the ways pilots can view meteorological data and other information pertinent to a flight. While technology changes, the elements of preflight preparation for a standard Visual Flight Rules (VFR) cross-country remain constant. Title 14 CFR 91.103 states that for "flights not in the vicinity of an airport, weather reports and forecasts, fuel requirements, alternatives available if the planned flight cannot be completed, and any known traffic delays of which the pilot in command has been advised by ATC" (FAA, 2018, p. 175). Furthermore, the pilot-in-command should be aware of all information relating to aircraft performance, airport elevation, runway slope, aircraft gross weight, wind, and temperature.

According to 14 CFR 91.103, sources that can be used for VFR flight information include: Sectional Charts, Chart Supplements, Notices to Airmen, the Airplane Flight Manual, and Weather Data for Aviation. Sectional Charts published by the Federal Aviation Administration are the main navigation reference tools used by pilots while flying under VFR. (FAA, 2018). Other than serving as a standard navigation tool for a standard VFR flight, the sectional aeronautical chart can provide wealth of information that a pilot can use such as

information of radio aids for navigation, airports, controlled airspace, special use airspaces, obstructions, certain radio frequencies, runway lighting systems, special use airspaces, and other related data.

A Chart Supplement is published by the FAA and contains operational information for every civil use airport open to the public in the United States. This includes location, elevation, runway and lighting facilities, available services, availability of aeronautical advisory station frequency, types of fuel available, Flight Service Station (FSS) located on the airport, control tower and ground control frequencies, traffic information, remarks, and other pertinent information (FAA, 2016b, p. 6-17).

Notices to Airmen are a great tool for pilots to retrieve the latest information about an airport or any amendment to information published in the sectional aeronautical chart or the chart supplement. For a VFR flight, this information can be runway closures, change of taxiway signs, change in radio frequency, closure of airspace, and other details. The most updated NOTAMs can be retrieved online from the official Defense Internet NOTAMs Services website (PilotWeb), Flight Standards District Office, or a Flight Service Station.

An Airplane Flight Manual (AFM) is the document published and developed by the aircraft manufacturer. This document contains the information such on weight and balance, aircraft performance, take-off and landing data, and operating limitations. Title 14 CFR Part 91 requires pilots to comply with the operating limitations mentioned in the AFM.

Weather Data for aviation is managed and published by the National Weather Service (NWS), FAA, Department of Defense (DOD), and other agencies. Weather observations and forecasts can be found on the official website of the Aviation Weather Center (AWC) or can be obtained from a FSS briefing. The data published on the AWC website or FSS brief usually contains coded information or large scale charts.

Traditional sources for preflight planning data such as weather-related data are usually difficult to interpret and require significant experience to use, while testing a pilot's ADM skills to make safe and efficient decisions. The FAA (2009) explains this difficulty for general aviation pilots: "with many weather providers and weather products, it can be very difficult for pilots to screen out non-essential data, focus on key facts, and then correctly evaluate the risk resulting from a given set of circumstances" (FAA, 2009, p. 1). In terms of weather data, interpretation of data from raw sectional charts, NOTAMs, chart supplements, and raw weather data requires significant skills and knowledge of the codes and symbols. Also, estimating the actual implications of certain codes and symbols can be a challenging task. For example, in a standard weather observation such as a METAR or Terminal Area Forecast (TAF), the intensity of rain can be displayed as either –RA, RA, or +RA which symbolize *Light*, *Moderate*, or *Heavy* (FAA, 2016a).

Understanding aircraft performance and capabilities requires significant knowledge of the aircraft's systems and components. Airplane Flight Manuals are often bulky and contain large amounts of information pertinent to the aircraft model. Being well-aware of the aircraft's flight manual and knowing how to use the manual at different situations of planning also requires

significant skill and experience. An electronic version of an AFM can be stored on an EFB making it easier for the pilot to find subject material and highlighted areas of importance.

Automation and EFBs in Flight Planning

The preflight planning for a typical VFR flight requires pilots refer to a wide variety of data sources and maintains knowledge and ADM skills to interpret raw data which is often coded. Electronic Flight Bags have made this process much easier for pilots. The introduction of EFBs have made it possible for all the data sources discussed in the previous section to be packed into a portable electronic device. Pilots no longer need to refer the chart supplements, raw weather data online, paper sectional charts, and physical AFM books to plan their flights. EFBs have the ability to superimpose information from various sources to deliver an enhanced preflight planning experience.

Pilots no longer need to be aware of METAR and TAF codes, formats of NOTAMs, and interpretation of performance charts in the AFMs. The EFBs can decode weather information into plain English, segregate NOTAM information according to the most significant notices for the date of the flight, present the information in easy-to-read language, and perform weight and balance or performance calculations for the pilots with the help of data input by the pilot just before a flight.

Rather than interpreting data from large scale charts such as Surface Analysis Charts, Weather Depiction Charts, or Radar Summary charts, pilots can now gain the same information by superimposing the data from the different weather charts and data sources onto the sectional charts and study the weather along the route flight. The capabilities offered by EFBs vary depending on the type of EFB used. Airline flight crews use more sophisticated and complex EFBs than typical pilots in a collegiate or flight training environment. Winter et al. (2017) argue that "EFBs increase safety because they provide more accurate information such as takeoff performance information using real-time data rather than data that has been rounded to the nearest 100 kgs [typical of paper charts because it is easier for humans to make these types of calculations]" (p. 2). The same can be applied to other factors of preflight planning such as weather data and airport data. Typically, pilots link the EFBs to the internet during preflight planning which allows the EFBs to update the data and ensure that the pilot does not operate the flight with any outdated or expired source of data.

Concerns

The primary concern this study aims to address is skill degradation in flight planning without the help of an EFB for pilots that have started using EFBs very early in their flying career. It is important that ab-initio pilots are well-versed to interpret and make safe decisions without the use of modern technology. That skill will likely be life-saving in a situation when an EFB fails or is not available. In the event of EFB failure, the pilots should be trained to be self-sufficient to make safe decisions.

Fundamental skill development is not only important for preflight planning, but also while flying the aircraft as well. Casner, Geven, Recker, & Schooler (2014) studied the impact of

automation on manual hand flying skills by testing pilots who were currently flying in airplanes with significant automation "to fly with and without each automation system through three different phases of flight" (Casner et al., p. 3). Serious concerns were raised when pilots were tested on their "cognitive skills that accompany manual flight" (p. 9) Pilots struggled to maintain situational awareness along different intervals of the flight and struggled to deal with emergencies while manually flying the airplane.

Research by Milner et al. (2017) studied the impact of EFBs on the response time of pilots to questions on given instrument approach plates. The study utilized a survey of 30 questions that consisted of inquiries related to different elements of approach plates presented by the investigators. The participant could use an EFB to answer the first 15 questions but had to rely on paper copies for the last 15 questions. The authors observed that response time was much quicker when the participants used EFBs rather than paper charts.

Methodology

This study was an applied research study with a mixed factorial design with within-subjects survey and between-subjects experimental components. This study was conducted at Embry-Riddle Aeronautical University, Daytona Beach, Florida. The participants were required to be either student pilots or private pilots and must not have logged more than 100 flight hours at the time of participation. The study focuses on this population because the population is inexperienced and in the process of skill development to be proficient pilots.

The sample size for this study was 40 participants. To achieve optimum results, a two-fold survey was designed. The study composed of a general opinion survey and a scenario-based simulation survey.

Sample Selection

The participants of this study were randomly chosen student pilots or private pilots who used EFBs in their flight training and had not logged more than 100 total flight hours. The study was advertised in the premises of the College of Aviation building of Embry-Riddle Aeronautical University, Daytona Beach through printed flyers. Any participant that wished to participate was able to contact the researcher through email. Participation in this study was voluntary and the participants were not compensated for their participation. The participants were students of Embry-Riddle Aeronautical University, Daytona Beach. Sixty percent of the participants were student pilots and the remaining 40% were private pilots. The average flight experience of all 40 participants was 58.1 total flight hours.

This study focused on pilots in the flight training environment and the participants were student pilots or private pilots with less than 100 flight hours. The study focuses on this population because the population is inexperienced and in the process of skill development to be proficient pilots.

More experienced pilots with more flight hours are less likely to have started their flight training with EFBs and their experience in different flight conditions would have an influence on their skill development, too. For this reason, testing inexperienced pilots with either a student or a private pilot certificate with less than 100 flight hours was decided to be the most appropriate population to study skill development in a flight training environment.

General Opinion Survey

Purpose. The purpose of the general opinion survey was to derive qualitative data from the participants on their dependency on EFBs, their decision-making process with and without EFBs, and their preparation methods for flights. All 40 participants taking part in this study took this survey. The survey derived responses from the participants to 10 statements relating to preflight planning methods and their dependency on EFBs. The list of questions is provided in Appendix A. The data was analyzed to identify trends and behavioral characteristics of EFB users on various cases presented through the survey questions.

Procedure. The survey was administered via Google Forms and data was gathered from March 2018 to April 2018. Participation was voluntary and the participants were not paid for their participation. The Embry-Riddle Aeronautical University Institutional Review Board authorized the study under protocol number 18-127. The survey was conducted in a tutoring lab in the College of Aviation of the University where the students were provided a computer to answer the questions. The participants were allowed to either use the EFB provided by the researcher or use their own EFB for the study. The EFB used for this study was Foreflight on an Apple iPad, as it was the only mandated EFB in the university's flight program (Embry-Riddle Flight Department, 2018). The questions in the general opinion survey were aimed at obtaining insights into operating practices of the participants and the influence EFBs had on those practices. All but two questions required participants to respond through Likert scales.

Scenario

Purpose. The purpose of the scenario survey was to derive quantitative data to measure the performance of the participants in the preflight scenario simulation. All 40 participants responded to this survey, but 20 participants used an EFB to answer the questions and the other 20 did not use an EFB to answer the questions. Participants were assigned to each group on an alternating basis. The first participant of the survey was assigned to the group that could use an EFB and the second participant was assigned to the group that could not use an EFB. This pattern of alternating the groups was followed for the 40 participants.

Scenario description & procedure. The scenario for this simulation was a Visual Flight Rules (VFR) Cross-Country from McGhee Tyson Airport (KTYS) in Knoxville, Tennessee to Dover Air Force Base (KDOV) in Delaware on March 18, 2018, at 0100Z. The researcher had selected this route on March 18, 2018, as it presented a challenging route in terms of weather and other factors such as the Washington Special Flight Rules Area present along the route of flight. The route had patches of Instrument Metrological Conditions and areas of thunderstorms during the time of the flight. The route of flight presented an opportunity for pilots to advertently enter IMC and the Special Flight Rules Area without adequate planning. At 0100Z, the researcher

collected all the pertinent weather data through ForeFlight, Aviation Weather Center, and DUATs to create the weather packet that was provided to the participants for the study. The researcher also used PilotWeb and ForeFlight to retrieve all the NOTAMs published for that time to include in the packet.

The participants that were not allowed to use an EFB were provided with a printed weather briefing from DUATs and weather charts such as the Surface Analysis Chart, Weather Depiction Chart, and Radar Summary Chart from AWC. They were also provided with printed NOTAMs from PilotWeb and Chart Supplements for the airports required in the scenario, and the sectional chart.

The participants that could use an EFB were provided the screenshots of the weather briefing from Foreflight and the screenshots of the NOTAMs from ForeFlight for the time of the flight. All the other data needed for the study could be retrieved from ForeFlight while completing the study.

Time critical information like weather data and NOTAMs was provided to the participants allowed to use an EFB through printed screenshots derived from Foreflight during the time of the simulated flight. All other data needed to answer the questions could be derived from the EFB used by the participants at the time they took the survey.

The group that was not allowed to use an EFB was provided with NOTAMs, chart supplements, a VFR Sectional Chart, and a printed weather briefing from Flight Service Station (DUATS) and ADDS Aviation Weather Center.

Data analysis. The scenario survey was analyzed under four categories: NOTAMs, Charts Interpretation, Weather Products, and Flight Information/Awareness. Participants had to answer 15 questions on the basis of a provided flight scenario from McGhee Tyson Airport (KTYS) in Knoxville, Tennessee to Dover Air Force Base (KDOV) in Delaware on March 18, 2018, at 0100Z. The four categories are critical components of planning any VFR Cross Country flight and were coherent to the information a pilot is required to obtain before a flight as per 14 CFR 91.103.

NOTAMs interpretation was tested from three separate incidents where the participant pilots needed to verify the runway status at KTYS, change in radio frequencies at KDOV, and detect a Temporary Flight Restriction along the route of flight. For this information, the participants could have referred to the list of NOTAMs for both the airports and all the airspaces for the entire route. A challenging aspect of not using an EFB for NOTAMs in the scenario was the sheer volume of NOTAMs and the varying subjects the NOTAMs addressed which made it difficult to segregate information, especially for ab-initio pilots. The pilot who could use an EFB (G2) were handed out briefs from Foreflight which categorized NOTAMs *Navigation*, *Communication*, *Service*, and *Obstructions within 10NM*. The illustration and segregation of complex data by the EFB is expected to play a major role in aiding participants in detecting relevant NOTAMs implementing them in their flight plans.

The participants who were not allowed to use an EFB (G1) were provided with a printed Flight Service Station (DUATS) brief for the flight and were provided with all the latest weather charts such as the radar summary charts, surface analysis charts, and weather depiction charts. Interpreting the weather data for this flight was a challenge as the weather did considerably change along the route of flight. G1 participants had to rely on data such as METARs and TAFs of the airports en-route, AIRMETs/SIGMETs/Convective SIGMETs, and weather charts. G2 participants were provided with the briefing available on the Foreflight application that was used for this study. The briefing utilized extremely illustrative methods to display the weather data. Airports along the route that did experience Instrument Flight Rules (IFR) weather were labelled red and those that experienced VFR weather were labelled green. Radar data can be superimposed on the exact route of flight with an illustration of the exact rate and direction of the thunderstorm cells. The areas for which AIRMETs, SIGMETs, and Convective SIGMETs have been issued can be shaded on the sectional chart with the advisory superimposed on the digital sectional chart. Information that is usually retrieved from different areas can now be consolidated and superimposed on each other to aid the pilots.

For the purpose of the analysis, all questions were categorized based on the proficiency they tested. The questions of the survey were analyzed under *NOTAMs, Charts Interpretation, Weather Products,* or *Flight Information/Awareness*. There were multiple questions that tested a single proficiency area; hence, the figures presented in the results represent the average scores of the participants of the two groups in each proficiency area. The NOTAMs category had four questions, Charts Interpretation had two questions, Weather Products had three questions, and Flight Information/Awareness had seven questions.

Appendix A lists all the questions that were included in the scenario survey of the study. The questions were categorized under NOTAMs, Charts Interpretation, Weather Products, or Flight Information/Awareness as the following:

- NOTAMS
    - You take-off and need to return back immediately. You can only land back on Runway 5. Can you land on Runway 5?
    - What is the current ATIS frequency at KDOV?
    - I do not need to worry about any TFRs on my route.

- Charts Interpretation
    - How do you plan to open your flight plan after taking off at KTYS?
    - Before you reach KDOV, you decide to divert to KAPG. Can you fly through R4001-A to reach KAPG. The time is 1:10AM Local on 18th March 2018. What is the status of the airspace? How do you verify it?

- Weather Products
    - There is considerable risk of me encountering IFR weather on the way
    - Refer to the radar imagery presented to you. There is considerable risk for me to cancel the flight or divert to different airport.
    - Examine the weather of PAVA airport. It is safe for me to land at the airport with a plane not equipped with anti-ice systems.

- Flight Information/Awareness
    - What fuel services would you be able to get in KTYS?
    - KTYS is an airport designated as an "Airport of Entry".
    - What are the noise abatement procedures at KTYS?
    - How do you plan to open your flight plan after taking off at KTYS?
    - On the way back to KTYS from KDOV I notice that that I am low on fuel. I land at KMKJ to take a break at 0730 Local time on 18th March. I expect the airport to be attended.
    - What is the Traffic Pattern Altitude at KDOV?
    - While en-route, you take a break at Lake Anna (7W4) Airport. What fuel services do you expect at that airport?

The average percentage scores of participants in each category have been scaled to a score of 20. The calculation of the score can be understood below:

Total questions in category: Q
Average score of G1/G2 participants in Category: X
Average Percentage: (X/Q) multiplied by 100=Y
Y scaled to a score of 20: (Y/100) multiplied by 20

A scale of 20 was chosen because the scale allowed the performance scores of G1 and G2 in each category to be distinguished easily on a graph. The scale of 20 was deemed appropriate for this analysis. The average percentage in each category can be scaled to any score for analysis and graphical display.

Results

The question addressed in Figure 1 serves as a self-evaluation for the participants for their self-confidence to read and interpret raw weather data. The number of people who do not feel confident of reading raw weather products outnumber the number of people who feel confident reading and interpreting raw weather data.

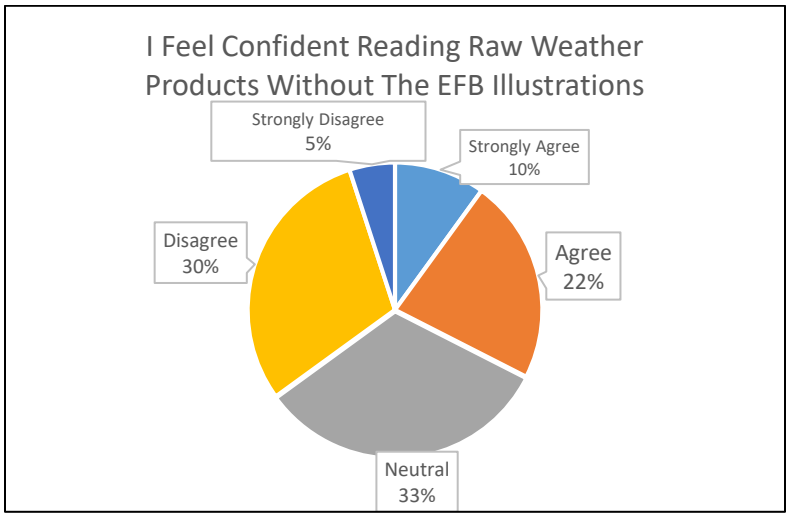


Figure 1. Interpreting raw weather products without EFB illustration.

The question addressed in Figure 2 is intended to get an insight into the operating practices of the participants. The majority of the participants do not carry printed NOTAMs and weather briefings to the flight when they do not use an EFB.

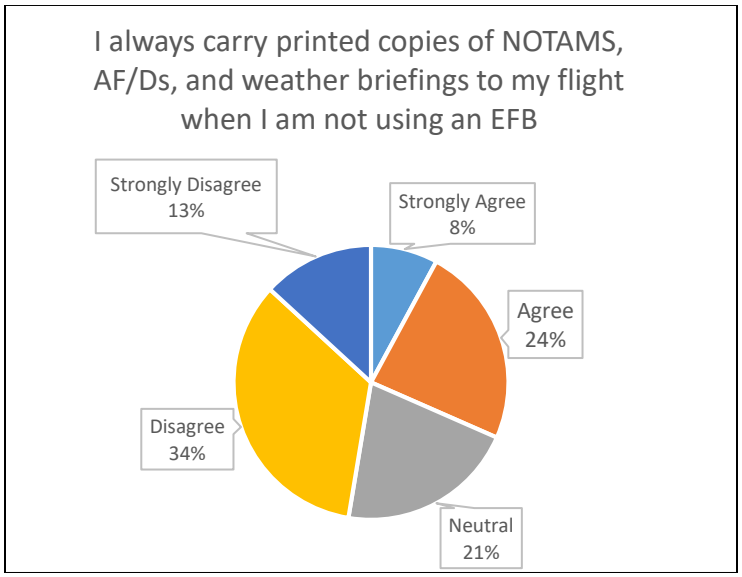


Figure 2. Printed products carried by pilots in flight.

The question addressed in Figure 3 is intended to get an insight into the planning methodology of the pilots when they do not use an EFB for preflight planning. A majority of pilots approximate headings, ground speeds, and timings when they do not use an EFB.

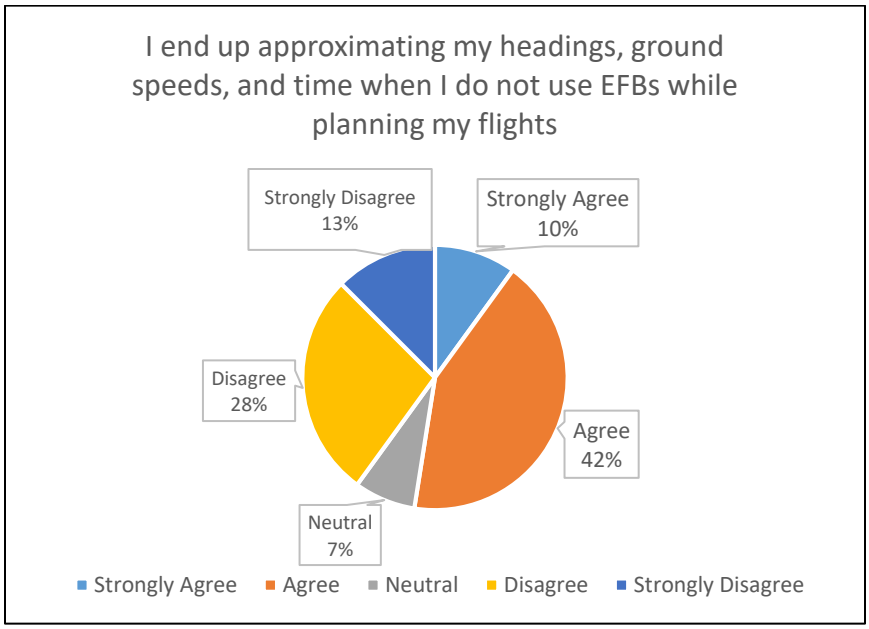


Figure 3. Approximation of navigation information when not using an EFB.

The question addressed in Figure 4 is intended to get an insight into the operating practices of the participants. The majority of the participants do carry back-up paper copies of charts and checklists and a manual plotter for their flight.

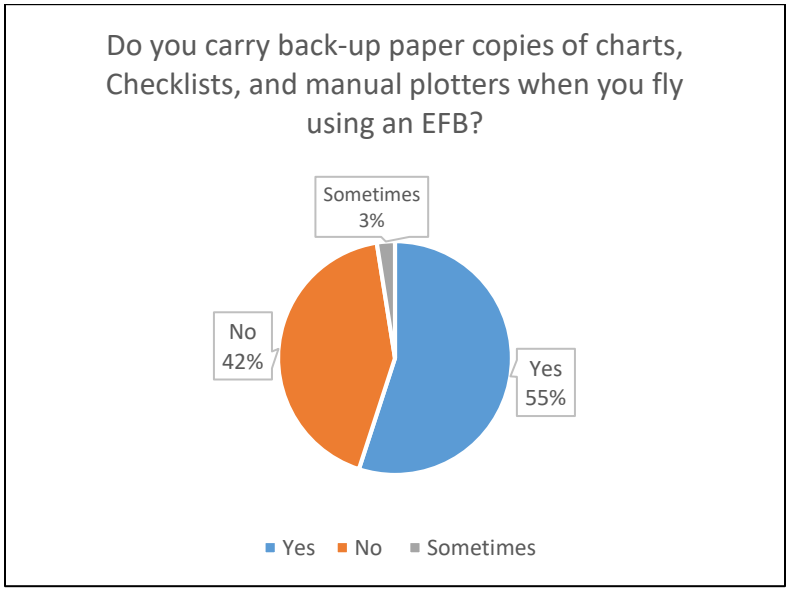


Figure 4. Backup products carried by pilots.

The question addressed in Figure 5 serves as a self-evaluation for the participants to evaluate whether they feel more proactive when using an EFB for preflight planning. A large majority of the participants do feel more proactive when planning a flight with an EFB.

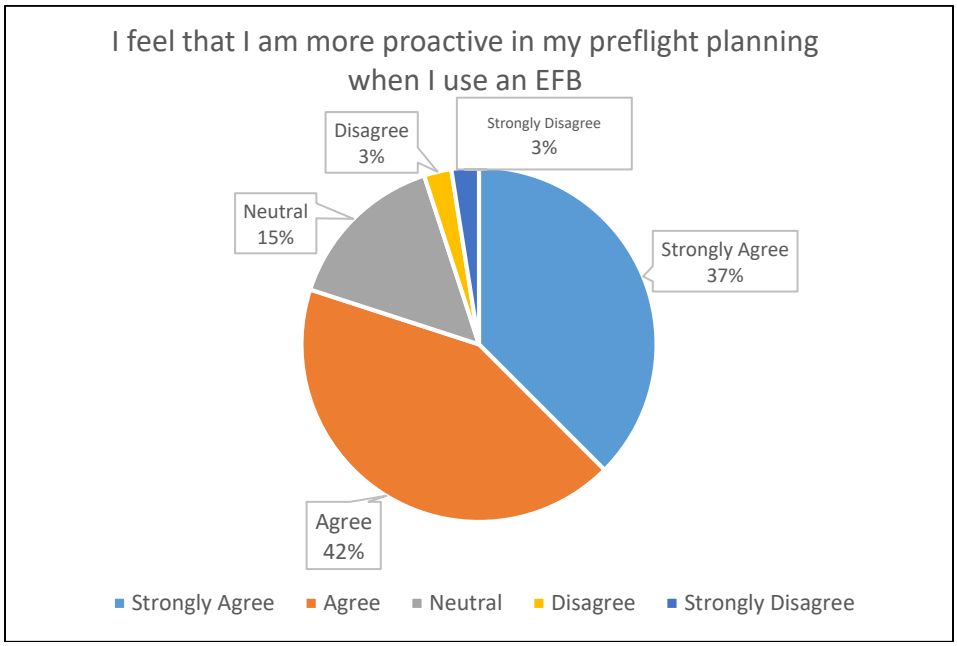


Figure 5. Participants feeling more proactive while planning with EFBs.

The question addressed in Figure 6 serves as a self-evaluation for the participants to assess their self-confidence to use a manual navigation plotter in flight. The majority of the

study population does feel confident when using a manual navigation plotter in flight if the EFB fails.

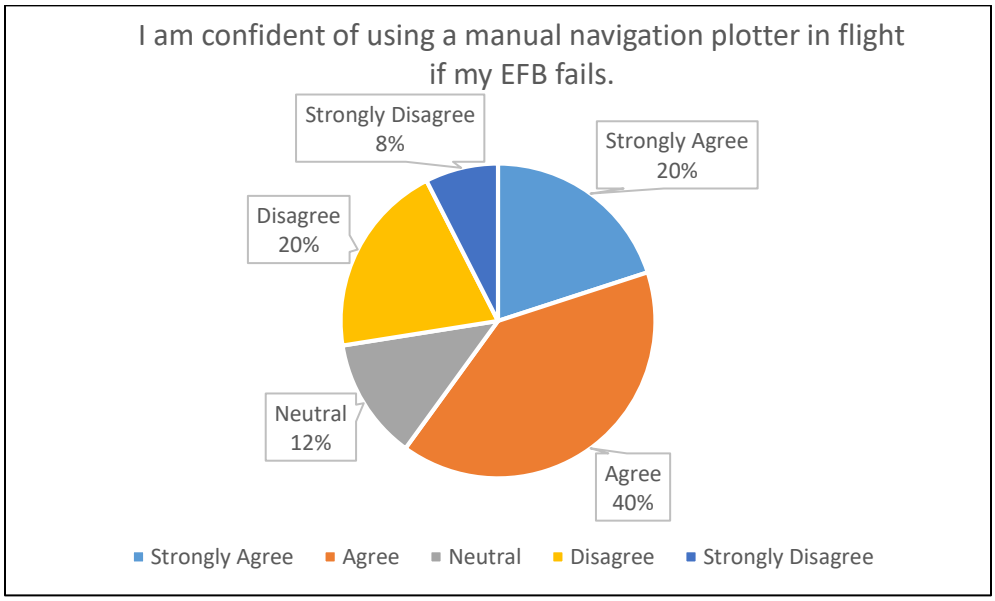


Figure 6. Using Manual Navigation Plotter in Flight.

The question addressed in Figure 7 serves as a self-evaluation for the participants to assess the impact of using EFBs on their fundamental skill development and data interpretation. A slight majority of participants feel that using EFBs in their flight training has a negative impact on their skill development and data interpretation skills.

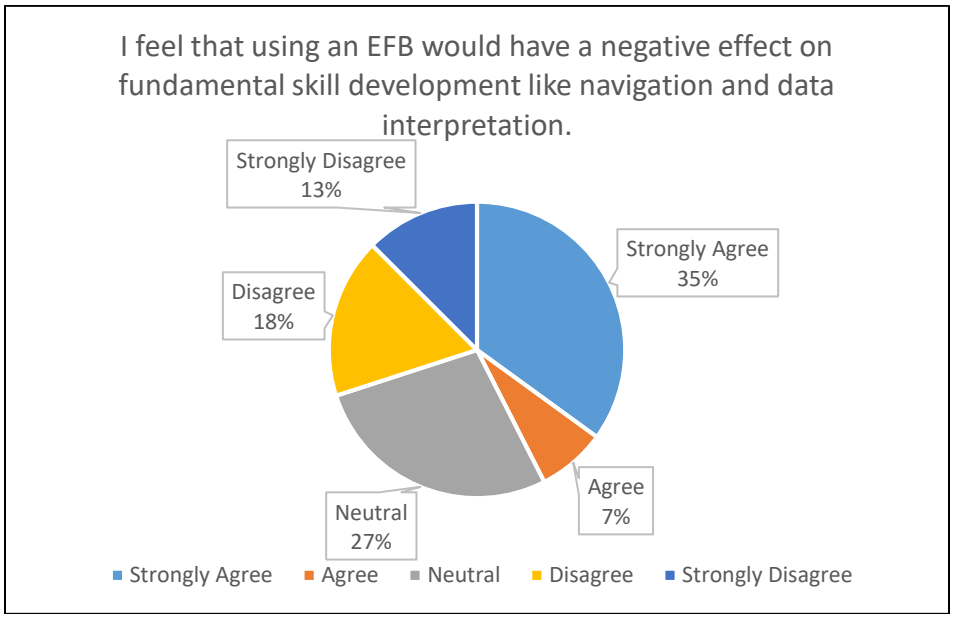


Figure 7. Effect of EFBs on skill development and data interpretation.

The question addressed in Figure 8 is intended to get an insight into the flight planning procedures of participants. The majority of participants are aware of the alternate airports they

can land, but do not read the NOTAMs, chart supplements, and weather briefings for those airports.

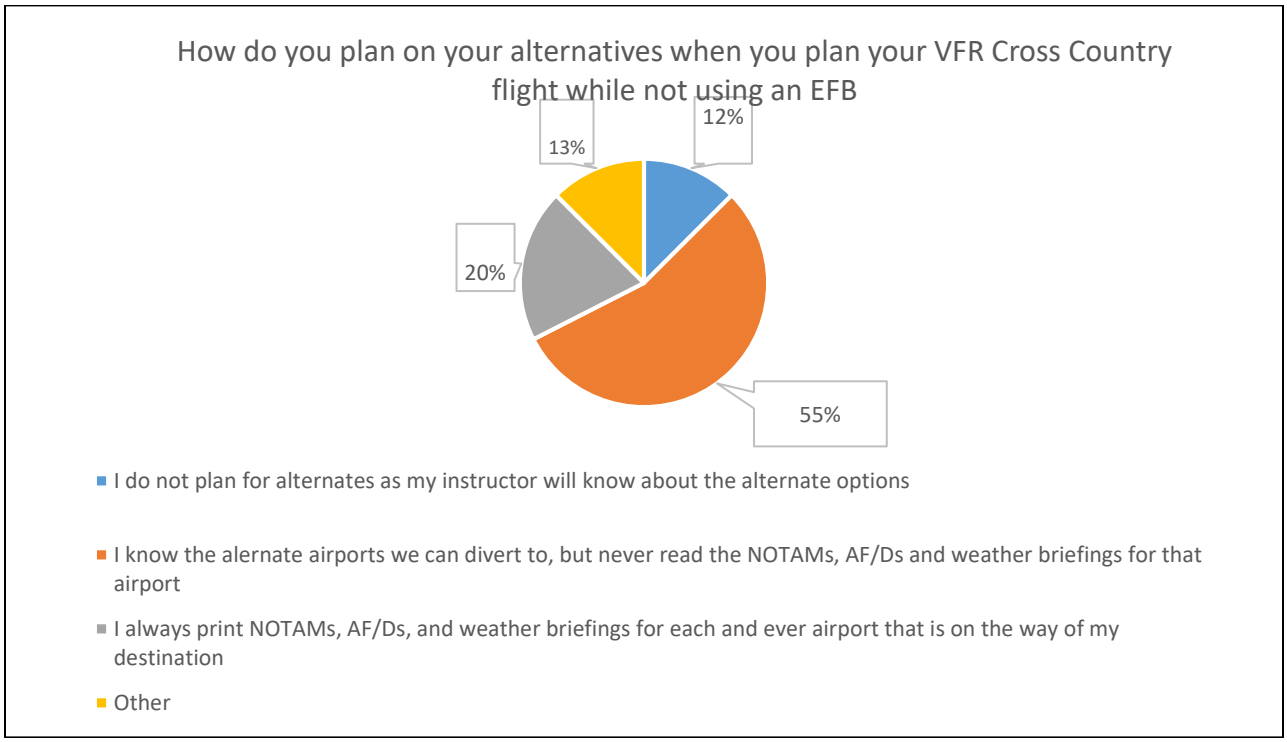


Figure 8. Planning of VFR cross-country alternates.

Scenario Survey Results

The scenario simulation required the participants to plan a VFR cross country flight from KTYS to KDOV on March 18 at 0100Z. The participants were questioned on multiple aspects of their flight planning such as alternate options, their decisions in response to weather reports in flight, the status of airspaces, and the information about the airports they intended to land or take-off.

For the purpose of non-wordiness, the groups will be referred to as the following:

- G1: Participants that did not use an EFB for the scenario
- G2: Participants that used an EFB for the scenario

Some of the outstanding observations from this study include:

- 85% of G2 were able to detect the Washington Terminal Flight Restriction (TFR) in comparison to 65% of G1
- 75% of G2 were able to determine a runway closure at the destination airport in comparison to 55% of G1
- 70% of G2 were able to determine the status of a restricted airspace in comparison to 60% of G1
- 65% of G2 were able to detect the change in radio frequencies at the destination airport in comparison to 35% of G1

For the purpose of the analysis, all questions were categorized on the basis of the proficiency they tested. The questions of the survey were analyzed under *NOTAMs*, *Charts Interpretation*, *Weather Products*, or *Flight Information/Awareness* (see Figure 9). There were multiple questions that tested a single proficiency area; hence, the figures presented in this section represent the average scores of the participants of the two groups in each proficiency area.

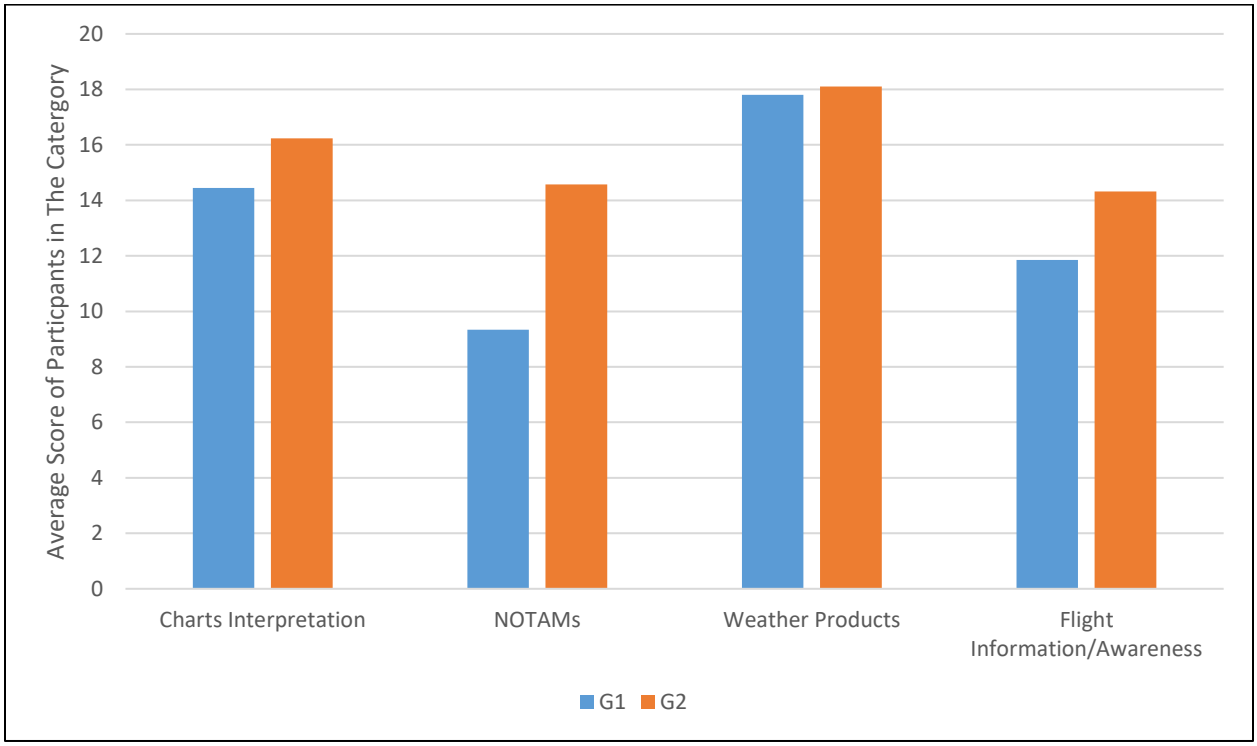


Figure 9. Performance analysis of participants in scenario survey.

Discussion

The purpose of the study was to evaluate the effects of utilizing Electronic Flight Bags in flight training with emphasis on preflight skill development and Aeronautical Decision Making. While the general survey served as a self-evaluation tool for the participants to provide data about their operating and flight planning practices, the scenario survey served as a tool to evaluate the differences in performance when participants accustomed to using EFBs regularly are required to plan the same flight with and without an EFB. The results of this study are relevant to current flight instructors, flight training administrators, and members of the collegiate aviation community to ensure that student pilots of today are self-reliant and safe professional pilots in the future.

While 79% of the participants felt more *proactive* while planning their flights with EFBs, there was a large degradation in preflight performance of the G1 participants that were not allowed to use an EFB for the scenario survey. The least degradation was observed when participants were asked to make decisions based on weather scenarios. The largest degradation was noted in NOTAMs interpretation.

It was noted that considerably fewer G1 participants were able to detect the Washington Special Flight Rules Area (SFRA). The added illustration of a red shaded circle superimposed on the sectional chart in the EFB aided the pilots using the EFBs to detect the Washington SFRA. The G1 participants only had a lengthy DUATs briefing and a navigation chart to help them identify the Washington SFRA. Pilots using EFBs were also able to perform slightly better than the G1 participants in questions related to weather data interpretation and decision-making along the route. The EFB was able to accurately depict the exact position and movement of thunderstorm cells, areas of Instrument Meteorological Conditions, and icing conditions by superimposing radar imagery and graphical illustrations on the sectional chart. Similarly, G2 participants were able to detect relevant NOTAMs more easily than G1 participants because the EFB segregates NOTAMs according to the time, duration, and status of the NOTAM. G2 participants were able to perform better on questions related to airport closures, fuel availability, frequencies, and traffic pattern altitudes because of the convenient segregation and presentation of data for each airport by the EFB. The G1 participants only had the chart supplements for the airports to answer the questions.

It is relevant to note that the largest degradation in performance of G1 participants in comparison to G2 participants was seen in this category. It is vital for ab-initio pilots using EFBs for their flight planning to develop the skills of detecting relevant information from airport and airspace NOTAMs without the use of EFBs as ignoring NOTAMs can not only hamper the safety of flight, but also place the pilots in risk of regulatory violation

Charts Interpretation was tested at two separate incidents in the scenario. A major area that was tested under Charts Interpretation was detecting the airspace status of the Restricted Area R 4001-A near Phillips Army Field (KAPG) in Maryland. As explained in the Aeronautical Information Manual under Section 4. 3-4-3, restricted airspaces are critical because “penetration of restricted areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants” (FAA, 2018, p. 659). To ensure safety of the flight, it is critical that pilots are well-aware of the status of airspaces that they plan to fly though. This skill extends beyond detecting restricted airspaces and is applicable to detecting any sort of airspace pilots might be flying through such as Military Operations Area, and Prohibited Areas For the participants that could not use an EFB (G1), there were multiple methods to obtain information regarding the status of the R 4001-A restricted area, one of which was referring to the keynotes in the sectional chart that was provided to them. Another method that pilots can use to detect the status of airspaces without a sectional is contacting an appropriate Flight Service Station of Air Traffic Controlling Agency. The keynotes section is the only method to obtain information regarding the restricted areas from the sectional charts. For the participants that were using an EFB for this survey (G2), the status of airspace was superimposed on the digital sectional chart on the Foreflight application. If the restricted airspace is shaded red, it implies that the restricted airspace is active and if the airspace is shaded orange/tangerine, it implies that the airspace is inactive. The possibility to consolidate information makes is easier for pilots to interpret navigation charts as a lot of information that is not available in normal physical copies of the sectional charts is superimposed on the digital sectional charts used on EFB software and applications. Pilots used to utilizing such digitalized versions of navigation charts might find it difficult to navigate and search for information when they are disabled of such application.

Weather interpretation is a key skill that needs to be inculcated in all pilots and developing that skill from the ab-initio level is extremely important. Weather data is disseminated to pilots from a variety of sources. It is important for pilots to not only interpret and make safe aeronautical decisions from the limited data they have, but also make sure that the data they are using to base their decisions are credible. Pilots often have to work with very little data to make safe decisions. Interpreting products such as radar summary charts, prognostic charts, surface analysis charts, and weather depiction charts which deliver weather data on a very large scale can be challenging for ab-initio pilots and make it difficult to interpret data for a particular route of flight within the country. This is fine when ADM skills come in play and the skill of interpreting the limited data to make decisions is critical.

Ab-initio pilots who have been trained early in their flight training with such illustrated and abridged data from EFBs might find it difficult to use raw data in a situation using an EFB is not possible.

Flight Information and Awareness is critical for the safe operation of any flight. This includes pilots ensuring planned airports for take-off, landing, refueling, alternates are attended to avail services, planning appropriate en-route and destination alternates to ensure that the appropriate services are available, and ensuring that all listed precautions and procedures listed for the airspaces and airports such as noise abatement procedures are adhered to. It is vital for pilots to attain the skills and knowledge to retrieve data from different sources to not only make the safest decisions, but also comply with regulatory and other advisory procedures. Ab-initio pilots that initiate their flight training with EFBs do possess a lot of information at their fingertips as modern EFBs de-clutter all important data about airports from sectional charts and Chart Supplements and present them in formats that are much more user-friendly. In situations when these pilots do not have the EFBs to retrieve this information, it is vital that such ab-initio pilots are trained to maintain the same level of proficiency in flight planning and being resourceful to retrieve data from different sources.

Limitations

The population of this survey was limited in its scope and sampling precludes generalization of findings. All the participants of the study were pursuing their flight training at the same flight training department of the university. Certain trends and results which were noticed might not be true for the general population but might only be true for the localized population from the university that is undergoing the same structure of training. A similar study with more participants and multiple institutions and geographical areas is recommended for further studies.

Conclusion

It can be concluded that while the introduction of EFBs is a welcome addition to flight training, considerable emphasis needs to be placed by flight training administrators to ensure that students are well-trained to sustain fine ADM and data interpretation without EFBs as well. Ab-initio pilots are very vulnerable to developing hazardous attitudes and unsafe flight planning

techniques due to inexperience and retain those techniques further on into their careers due to the principle of primacy.

Through this study, we observed that the introduction of EFBs in flight training can have an impact in terms of fundamental skill development for preflight planning as participants that did not have an EFB for the study performed worse on the scenario simulation than the participants who were able to use the EFB. Participants who were not allowed to use an EFB performed worse in interpreting NOTAMs, sectional charts, Chart Supplements, and weather data. Decision making was evaluated in the scenario survey mainly through weather products. The route of flight did contain Instrument Metrological Conditions and the radar images did predict thunderstorms in the vicinity of the route planned for the flight. The results of the scenario survey showed that participants who did not use an EFB for the survey were less likely to detect weather-related hazards. Even in terms of airspace closures and regulations, participants that were not allowed to use the EFB performed worse when required to detect the Washington SFRA and Restricted Area R4001-A.

Ab-initio pilots are not exposed to decision making while utilizing raw data in the modern training environment where pilots use advanced EFBs in the early stages of their flight training. The ease of preflight planning with EFBs can have a negative impact on the ability of ab-initio pilots to interpret, analyze, and make decisions when not using an EFB. Pilots can either become complacent while referring to briefs and miss out on important information such as SFRAs, airport restrictions, or airspace closures or pilots can also be overwhelmed with the amount of data that is normally presented in an FSS briefing which can span several pages when printed. Interpreting and analyzing large amounts of data to make decisions is an important process that every pilot needs to be proficient in and the usage of EFBs in the early stages of flight training can hamper the development of this skill. It is important for flight instructors to ensure that while students who use EFBs are well-equipped with the latest technology to better prepare them for the future, students should also be well-trained to deal with EFB and other automation failures and be proficient in using other resources.

This study analyzed the impact of the introduction of EFBs in flight training curriculum on the knowledge of interpreting raw aviation data (such as Notices to Airmen, METARs, and Charts Supplements). The results of this study indicate that when ab-initio pilots use EFBs during the initial stages of their flight training, there may be a negative impact on their knowledge of interpreting raw aviation data. Participants who were not allowed to use an EFB in the study scored lower on the scenario-survey than the participants that could use an EFB. This was evident in all four categories (NOTAMs, Weather Products, Flight Information/Awareness, Charts Interpretation) that the questions were categorized into. The largest degradation in performance was noted in NOTAMs interpretation.

This study also analyzed whether ab-initio pilots display comparable levels of decision making when they do not possess an EFB to plan a flight and make decisions based on raw aviation products (unanalyzed and unprocessed data). The results of this study indicate that when ab-initio pilots use EFBs during the initial stages of their flight training, there may be a negative impact on their decision-making skills during flight planning when not using an EFB. This was evident in the scenario survey when participants who did not use an EFB were less likely to

detect IFR conditions, thunderstorms, closed runways in airports, and restricted airspaces in their route of flight while planning their flight. Because this study used a relatively small sample size and was localized to one university's flight training department, the researchers recommend further research in the area of EFBs and flight training.

References

Casner, S. M., Geven, R. W., Recker, M. P., & Schooler, J. W. (2014). The retention of manual flying skills in the automated cockpit. *Human Factors*, 56(8), 1506-1516. https://doi.org/10.1177/0018720814535628

Chandra, D.C., Yeh, M., Riley, V., and Mangold, S.J. (2003). *Human factors considerations in the design and evaluation of electronic flight bags (EFBs)*: Version 2. Office of Aviation Research, Washington, DC.

Chase, S., & Hiltunen, D. (2014). *An examination of safety reports involving Electronic Flight Bags and Portable Electronic Devices*. Human Factors Division, Federal Aviation Administration, U.S. Department of Transportation. Retrieved from http://fsims.faa.gov/wdocs/other/examination%20of%20safety%20report %20involving%20efbs%20and%20peds.pdf

Embry-Riddle Aeronautical University Flight Department. (2018). Flight Operations Manual. Daytona Beach, FL: Author.

Federal Aviation Administration. (1991). *Advisory Circular 60-22: Aeronautical Decision Making.* Retrieved from https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_60-22.pdf

Federal Aviation Administration. (2007). *Advisory Circular 91.78: Use of Class 1 or Class 2 Electronic Flight Bag (EFB).* Retrieved from https://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go /document.information/documentid/73540

Federal Aviation Administration. (2009). *General aviation pilot's guide to preflight weather planning, weather self-briefings, and weather decision-making.* Retrieved from https://www.faasafety.gov/files/gslac/courses/content/25/185/GA%20Weather%20Decision-Making%20Dec05.pdf

Federal Aviation Administration. (2016a). *Advisory Circular 00-45H: Aviation Weather Services.* Retrieved from https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_00-45H.pdf

Federal Aviation Administration. (2016b). *Pilot's handbook of aeronautical knowledge*. Washington, D.C.: Author.

Federal Aviation Administration. (2018) Federal aviation regulations/Aeronautical information manual 2019. Washington, D.C.: Author.

Milner, M. N., Bush, D., Marte, D., Rice, S., Winter, S., Adkins, E., … Tamilselvan, G. (2017). The Effect of Chart Type on Pilots' Response Time. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 61(1), 1365-1368. https://doi.org/10.1177/1541931213601824

Waldock, W. (2017). Aircraft automation and the degradation of pilot skills: keeping our skies safe [Webinar]. Retrieved from. http://worldwide.erau.edu/webinars/aircraftautomation-degradation-pilot-skills

Winfred, A., Bennett, W., Stanush, P., McNelly, T. (1998). Factors that influence skill decay and retention: a quantitative review and analysis. *Human Performance*, 11(1), 57–101. http://dx.doi.org/10.1207/s15327043hup1101_3

Winter, S.R., Milner, M.N., Rice, S., Bush, D., Marte, D.A., Adkins, E., Roccasseca, A., Rosser, T.G., Tamilselvan, G. (2017). Pilot performance comparison between electronic and paper instrument approach charts. *Safety Science*, March 2018, 280-286 https://doi.org/10.1016/j.ssci.2017.12.016

Appendix A

Survey Questions

General Survey

- I Feel Confident Reading Raw Weather Products Without The EFB Illustrations
- I always carry printed copies of NOTAMS, AF/Ds, and weather briefings to my flight when I am not using an EFB
- I end up approximating my headings, ground speeds, and time when I do not use EFBs while planning my flights
- Do you carry back-up paper copies of charts, Checklists, and manual plotters when you fly using an EFB?
- I feel that I am more proactive in my preflight planning when I use an EFB
- I am confident of using a manual navigation plotter in flight if my EFB fails.
- I feel that using an EFB would have a negative effect on fundamental skill development like navigation and data interpretation.
- How do you plan on your alternatives when you plan your VFR Cross Country flight while not using an EFB

Scenario Survey

Flight Details

You are flying from KTYS to KDOV on 18th March 2018. Your take off time is 0100Z. All weather data and NOTAMs provided are current as of 0100Z on 18th March 2018. If any questions requires data interpretation or decision making at a time other than 0100Z, the particular question will state the time and corresponding data will be provided to you. For participants using EFBs, you have been provided with only the weather data and NOTAMs as of 0100Z March 2018. You should use the EFB for all the other data required in this survey. For participants not using an EFB, you are provided with the route on a sectional chart(Not to scale) and the AF/Ds as well on top of the weather and NOTAMs.

- What fuel services would you be able to get in KTYS?
- KTYS is an airport designated as an "Airport of Entry". True or False?
- What are the noise abatement procedures at KTYS?
- How do you plan to open your flight plan after taking off at KTYS?
- You take-off and need to return back immediately. You can only land back on Runway 5. Can you land on Runway 5?
- I do not need to worry about any SFRAs on my route.
- There is considerable risk of me encountering IFR weather on the way
- Refer to the radar imagery presented to you. There is considerable risk for me to cancel the flight or divert to different airport.
- Before you reach KDOV, you decide to divert to KAPG. Can you fly through R4001-A to reach KAPG. The time is 1:10AM Local on 18th March 2018. What is the status of the airspace? How do you verify it?
- On the way back to KTYS from KDOV I notice that that I am low on fuel. I land at KMKJ to take a break at 0730 Local time on 18th March. I expect the airport to be attended.
- What is the ATIS frequency at KDOV?
- What is the Traffic Pattern Altitude at KDOV?
- Examine the weather of PAVA airport. It is safe for me to land at the airport with a plane not equipped with anti-ice systems.
- While en-route, you take a break at Lake Anna(7W4) Airport. What fuel services do you expect at that airport?

Collegiate Aviation Review International

Volume 37 | Issue 2 Peer-Reviewed Article #3

6-27-2019

The Usability of an Online Learning Management System in an Aviation Curriculum Blended Course Design: A Case Study

Tyler Bachelder
Metropolitan State University of Denver

Derren Duburguet
Metropolitan State University of Denver

James L. Simmons
Metropolitan State University of Denver

George G. King
Metropolitan State University of Denver

Thomas J. De Cino
Metropolitan State University of Denver

The Aviation and Aerospace Science Department of Metropolitan State University of Denver has implemented a third-party Learning Management System (LMS) to standardize learning content in Aviation Fundamentals and Instrument Fundamentals, two core courses in the degree curriculum. Shifting primary content delivery to the online LMS allowed individual instructors to experiment with blended teaching techniques. In an effort to assess the usability of this course design, a survey of all student users was conducted. The findings presented in this article include data regarding the overall usability of the LMS system as well as student satisfaction and their preferences surrounding the blended format.

Recommended Citation:
Bachelder, T., Duburguet, D., Simmons, J.L., King, G.G., De Cino, T.J. (2019). The Usability of an Online Learning Management System in an Aviation Curriculum Blended Course Design: A Case Study. *Collegiate Aviation Review International*, 37(2), 38-57. http://dx.doi.org/10.22488/okstate.19.100215

Starting in the fall semester of 2012, the Aviation and Aerospace Science Department at Metropolitan State University of Denver (MSU Denver) adopted a web-based Learning Management System (LMS) provided by a commercial vendor to deliver course content for a lower-division core course, Aviation Fundamentals, which is required for all curriculum concentrations in the Department. This course serves two purposes: 1) to cover the aeronautical knowledge areas pertinent to private pilot certification, and 2) to provide an overview of core foundation level concepts in aviation for first year students. Given the significance of this course in the degree curriculum and the multiple sections of Aviation Fundamentals each semester, the LMS was introduced, in part, to improve standardization of course content. In the fall semester of 2013, a similar LMS was also adopted for Instrument Fundamentals, another lower division core course in the program that covers the aeronautical knowledge areas required for an instrument rating.

The implementation of the online training system in the Department was not intended to be in lieu of a classroom environment, but rather a blended experience that includes the student-instructor interaction in the classroom. The online training material managed through the LMS supplements the classroom experience, much like a textbook does. Unlike a textbook, however, the LMS records student progress through the course content. The LMS framework also allows instructors to assess the students' level of understanding of topics prior to meeting in class. This feedback provides the instructor with real-time information that can be used to adjust the lesson plan to better focus on deficient knowledge areas during class time. In addition, by moving a majority of the course content delivery to the web, instructors can utilize time spent in the classroom to work with students on application level exercises and discussions that reinforce the online content. This approach to instructional design, known as the inverted or flipped classroom, is rapidly gaining momentum in education (Millard, 2012; Tucker, 2012).

The purpose of this study was threefold: 1) to assess the usability of the LMS, 2) to gauge how well the LMS was being integrated into curriculum, and 3) to evaluate student perceptions and preferences concerning the course content delivered through the LMS. Data from this study show the online content is generally being well integrated into the course and students are benefitting from the use of the LMS as a means of improving retention of the course material. Additionally, students appreciate the engaging interactive aspects of the training material, which are images, graphics, animations and narration, as compared to traditional textbook formats.

While data from this study reflect the usability and format of this specific LMS, general themes with regard to aviation student preferences are identified. These themes offer a benchmark for programs looking to implement a similar system in their curriculum or develop their own online content to be used in a similar instructional design. These data are already being used by the MSU Denver Aviation and Aerospace Science Department to support a shift away from commercially available LMSs towards the development of in-house content. This includes leveraging readily accessible open educational resources (OER), such as the FAA handbooks, which reduces course material costs for the student.

Literature Review

Since the late 1980s "e-learning" has been expanding in many facets of aviation education (Kearns, 2010). Kearns (2010, p. 12) describes e-learning as "a shortened version of the term electronic learning. This method of training provides educational materials, computer-mediated communication (CMC), and the delivery of instructional content through electronic technology [citation omitted]. This electronic technology may take the form of the Internet or an organization's intranet."

A Learning Management System (LMS) is an instance of e-learning that facilitates content delivery and provides course management tools for instructors and administrators. One definition of an LMS describes the system as "software used for delivering, tracking and managing training/education. LMSs range from systems for managing training/educational records to software for distributing courses over the Internet and offering features for online collaboration" (Mahnegar, 2012, p. 148). "An LMS is a platform that allows an entire organization to manage, create, and track e-learning" (Kearns, 2010, p. 17). Further, an LMS "allows for teachers and administrators to track attendance, time on task, and student progress" (Mahnegar, 2012, p. 148).

There are only a few mentions in the aviation education literature of *usability* of or *satisfaction* with aviation education LMSs. In one example, reference is made to "satisfaction" of students regarding content of the Leadership in Aviation course at Griffith University that had been converted to online content. The only description of the measurement of *satisfaction* is in response to the question, "This course engaged me in learning," but no statistics were given quantitative measurement (Kille, Bates, & Murray, 2015, p. 88).

The subjects of both *usability* and *satisfaction* of students using an LMS in an online course for the aviation doctoral program at Embry-Riddle Aeronautical University are mentioned in Neal & Hampton (2016). However, the subject of *usability* is limited to describing how setting up the course contains several issues, among them being "…internet technologies carrying unforeseen usability difficulties" (Neal & Hampton, 2016, p. 8). The subject of *satisfaction* in the course was measured by a survey item: "How likely is it that you will recommend this course to another student?" (Neal & Hampton, 2016, p. 27).

In recent work, Kearns, Mavin, & Hodge (2016) describe the typical use of LMSs in college and university aviation education environments as a component of "blended learning," in which web-based LMSs "support classroom teaching through a portal that learners and instructors use to distribute messages, media, grades and other classroom materials" (p. 140). In this work, there is no discussion of usability or satisfaction of LMS systems.

In a broad context, our study's emphasis on *usability* of the LMS fits into the *summative* evaluation category described by Kearns (2010), what she describes as "each learner's positive or negative feelings toward training" (p. 156). However, her discussion contains no specific focus on *usability* issues, such as those formulated by Brooke (1996).

In very recent work, Dusenberry and Olson (2019) explored the impact of "flipped learning" (a form of blended learning) on student perceptions and academic performance. The study was conducted with a small case group of eighty-one students studying human factors in aviation comparing subgroups of flipped learning students and traditional lecture students. Their study results indicated the flipped learning group did not perform better than the lecture group, and that the lecture group reported higher overall course satisfaction (Dusenberry & Olson, 2019).

Aside from aviation-specific studies, the review of the literature did not uncover many general studies evaluating student attitudes and satisfaction of LMS environments measured with the System Usability Scale (SUS) questionnaire. In a limited meta-review, Orfanou, Tselios, and Katsanos (2015) found a mere eleven studies in which students were surveyed on the usability of LMS environments. The SUS questionnaire was used to survey more than 750 students across the eleven studies reviewed. These studies evaluated the usability of two similar LMS platforms (Moodle and eClass) to the LMS platform Blackboard

Method

To evaluate the student perception of the online learning experience using an LMS platform, a survey was developed and handed out to students each semester, which was deemed exempt from IRB review. The surveys were conducted during the last four weeks of the regular 16-week semester for each Aviation Fundamentals and Instrument Fundamentals sections being offered. Instructors administered these surveys to the students during regular class time. Soliciting student responses at least 12 weeks into the semester gave the students sufficient opportunity to interact with the online system and develop experience with the software beyond an introductory level. The surveys allowed students to anonymously reflect upon their experience with the online system up to that point in the semester and provide feedback of their experience using the software. Data from the surveys were gathered for all spring and fall semesters between fall 2012 and spring 2017. During the fall 2012, spring 2013 and fall 2013 semesters, modifications to the surveys were made, as questions and statements were included to capture additional information with regards to declared majors and overall system usability. The survey stabilized for the 2014 academic year, but due to the earlier additions and modifications, some of the feedback gathered does not reflect this entire timeline. In addition, several questions on the survey pertained directly to administrative curriculum details that are outside the scope of this study and are therefore not included.

System Usability Scale Test

A System Usability Scale test was incorporated into the survey to assess students' perception regarding general usability of the LMS, referred to in the survey as the online training system. The SUS score is a benchmark rating for assessing, by the user group, the usability of a system that requires human interaction (Brooke, 1996). SUS tests are not specific to any one particular technology, and as such have been employed to generate usability benchmarks for a broad spectrum of products (Kortum & Bangor, 2013). Quantifying usability for the LMS was a revealing exercise for this case study. A student's capability to interact successfully with the online training system in an efficient and satisfactory manner can, to some degree, be inferred

from the system's usability (International Organization for Standards [ISO], 1998). A low usability score in this case study would suggest dissatisfaction with the product interaction, possibly due to systemic problems with the LMS design and/or implementation. A high usability score, however, would only suggest user satisfaction regarding interaction with the LMS. In either case, further feedback from the students is required in order to reveal a more in-depth perspective on student satisfaction with the overall implementation.

The SUS test used in this study is shown in Figure 1 and was modified from Brooke (1996). Statement numbers 1, 4, and 5 were slightly modified from the original to directly address the LMS. Simple modifications to the SUS statements have been shown not to affect the usability scoring results (Bangor, Kortum & Miller, 2008; Sauro, 2011).

In the original Brooke (1996) SUS test, statement 1 was: "I think I would like to use this system frequently." Since the purpose of the online training system for Aviation Fundamentals and Instrument Fundamentals is to deliver content material and assess the student understanding of that material, the more appropriate statement: "I believe the online training system helps me better understand the course material" was used to take into account the goal of the system. Statement 4 was modified from "I think that I would need the support of a technical person to be able to use this system" to "I could have used more training on how to use the online system." Again, the original statement as worded is too generic and does not reflect the context of the instructor-student relationship for this application. Finally, statement 5 was also modified to reflect the integration of the LMS with the traditional in-person course offering. The original statement in the Brooke (1996) SUS test is: "I found the various functions in this system were well integrated" was changed to "I found the various ground lessons in this system were well integrated with the course." The content of the online training system is organized into modules called "ground lessons," which are referenced by the students.

Open-Ended Answer Survey Questions

The elements of system usability, as outlined in ISO (1998), pertain to a user being able to achieve a stated goal through performing tasks, or activities, within the context of a system. These elements are 1) *effectiveness* – the ability to achieve goals, 2) *efficiency* - the expenditure of time and resources in performing tasks to achieve goals, and 3) *satisfaction* - the extent to which the user finds the product acceptable in achieving goals (ISO, 1998). In the context of the online training system discussed here, the goal of this implementation is content delivery of aeronautical knowledge areas in an environment outside the classroom setting. The ground lesson modules and assessments of the LMS are the structure by which this goal is achieved. In the ISO (1998) recommendations for usability analysis, user perception can provide an indication as to the efficiency and satisfaction of interacting with the system being evaluated. Learner perspectives, on the other hand, are not considered direct measures of effectiveness (Means, Toyama, Murphy & Baki, 2013). Positive and negative comments from the user group can therefore reveal efficiency issues, which relate to the time to complete tasks, in addition to overall satisfaction, which reflects user attitudes towards the product (ISO, 1998).

To capture student perceptions as they pertain to usability, the survey posed two questions requiring an open-ended written response from the participants (see Figure 2). These

two questions allowed the student to share positive and negative comments of their experience using the system. The written responses to these questions were categorized into common themes (see Table 1).

1.	I believe the online training system helps me better understand the course material: (*modified*)				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
2.	I found the online training system unnecessarily complex.				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
3.	I thought the online training system was easy to use.				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
4.	I could have used more training on how to use the online system. (*modified*)				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
5.	I found the various ground lessons in this system were well integrated with the course. (*modified*)				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
6.	I thought there was too much inconsistency in this online training system.				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
7.	I would imagine that most people would learn to use the online system very quickly.				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
8.	I found the online training system very cumbersome to use.				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
9.	I felt very confident using the online training system.				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
10.	I needed to learn a lot of things before I could get going with this online training system.				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Figure 1. Modified System Usability Scale (SUS) Test based on Brooke (1996)

- What aspect of the online training system did you find the **most** useful?
- What aspect of the online training system did you find the **least** useful?

Figure 2. Open-ended survey questions

Table 1
Student Feedback

Usability Element	*Theme*	*Description*
Satisfaction	Interface	Comments pertaining to the interface design.
	Presentation	Comments pertaining to the presentation, animations, audio and videos.
	Assessments	Comments pertaining to quizzes, exams, and other assessment tools provided.
	Content	Comments pertaining to the lesson material.
Efficiency	Performance	Comments pertaining to the efficiency and ease of use.
	Accessibility	Comments pertaining to the readily accessible content in an online training environment.
	Repetitive	Comments pertaining to the redundancy between class and online content.
	Length	Comments pertaining to time on task.

Likert-item Survey Statements

The survey recorded Likert-item responses to two general statements regarding the student experiences and perceptions using the online system. Additionally, the responses to two specific SUS statements were analyzed. These questions, presented in Figure 3, were intended to gauge student reaction to the desirability of employing similar systems in other core curriculum classes.

For each statement in Figure 3, the Likert-item responses included five options: *Strongly Disagree*, *Disagree*, *Neither Agree nor Disagree*, *Agree*, and *Strongly Agree*. The option of *Neither Agree nor Disagree* alleviates the need to state a level of agreement or disagreement with the question posed when students did not feel strongly one way or the other. Students who selected *Strongly Disagree* or *Disagree* rejected that particular statement in the survey while the students who selected *Strongly Agree* or *Agree* accepted the statement.

- I would like to see more aviation classes adopt an online training system.
- I prefer to use the online training system rather than the textbook.
- I believe the online training system helps me better understand the course material. (SUS statement 1)
- I found the various ground lessons in this system were well integrated with the course. (SUS statement 5)

Figure 3. Likert-item survey statements to gather general student feedback about utilizing the LMS.

Results

The particular LMS used by MSU Denver remained largely static throughout the survey period in both the content presented as well as the system architecture and appearance. While an

evaluation of year-to-year feedback was completed as part of the data analysis, the yearly trends are generally similar. For this reason and for the simplicity of the data representation, the results presented below have been aggregated across the entire span of the surveyed semesters.

SUS Test Results

The results from the SUS test on the student surveys from spring 2013 through spring 2017 were converted into SUS scores. For a discussion on how to arrive at a SUS score when analyzing the SUS test results, refer to Brooke (1996).

Figure 4 shows the distribution of the SUS scores for this study using a box plot, which represents data quartiles using the 25th, 50th, and 75th percentile ranges. The central box represents the "inter-quartile range" and represents the central 50% of the data (Krzywinski, 2014). According to Krzywinski (2014), a box plot is preferred for data distributions which are not symmetrical or do not contain significant outliers.

The mean SUS score for the LMS in this study was 67.5 with a range from 10 to 100. SUS scores in the high 50s and 60s are generally considered marginal usability scores (Bangor et al., 2008). However, Bangor et al. (2008) also found that the mean SUS score from multiple surveys conducted specifically on web-based applications was 68.05 with a standard deviation of 21.56 (n=1180). Sauro (2011) also points out that the average SUS score from almost 500 studies with over 5,000 participants and encompassing a wide variety of systems was 68. For the LMS in this study, the average SUS score of 67.5 was just below average on the usability scale and well within one standard deviation of the web-based applications' average SUS score (Bangor et al., 2008). These findings suggest that the online training system's usability is in line with the results from other web-based applications that have been surveyed with the SUS test. This marginal SUS score, however, is not revealing one way or the other concerning student satisfaction.

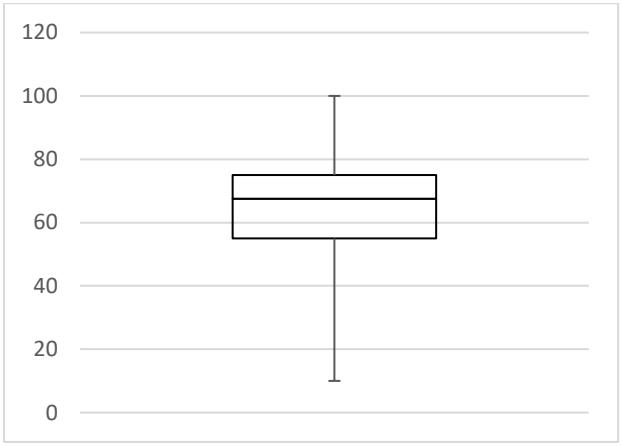


Figure 4. The box plot of SUS Scores for the online training system (N=610).

Open-Ended Survey Results

The results in Figure 5 show what students found to be the most useful with the online training system. The top three most useful aspects identified were: 1) presentation, 2) content and

3) assessments. These three categories accounted for 524 of the total 614 responses, or approximately 85%.

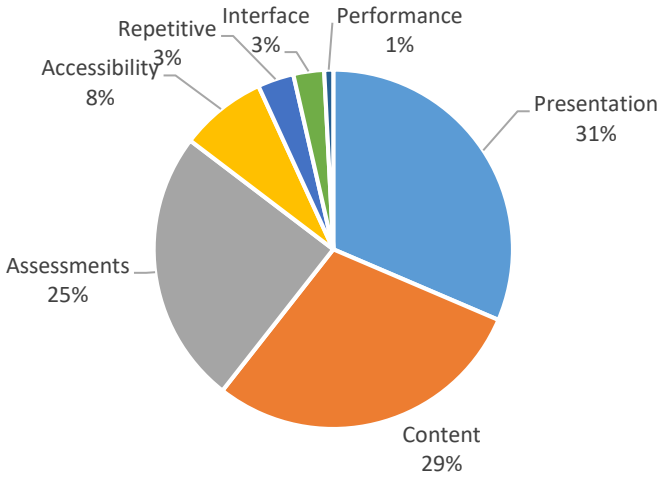


Figure 5. Student responses to the question: "What aspect of the online training system did you find the **most** useful?" (*N*=614).

The results in Figure 6 are the categorized student responses to the question: "What aspect of the online training system did you find the least useful?" Of the 526 responses submitted for this question, 158 (30%) indicated that the length of the lessons was least useful. One of the key issues identified early in the adoption of the online training system was the length of the individual ground lessons, or time on task efficiency (King & Duburguet, 2013). Tucker (2012) suggests that online content should explain concepts in clear and concise chunks in order not to exceed a student's attention span. The sample videos highlighted by Tucker (2012) are 4-6 minutes in duration. Evaluating the time spent by the students on every individual lesson attempted in the current study, the mean ground lesson time was 1 hour 3 minutes for the Aviation Fundamentals course and 36 minutes for the Instrument Fundamentals course. A logical conclusion is that the LMS lessons are longer than ideal.

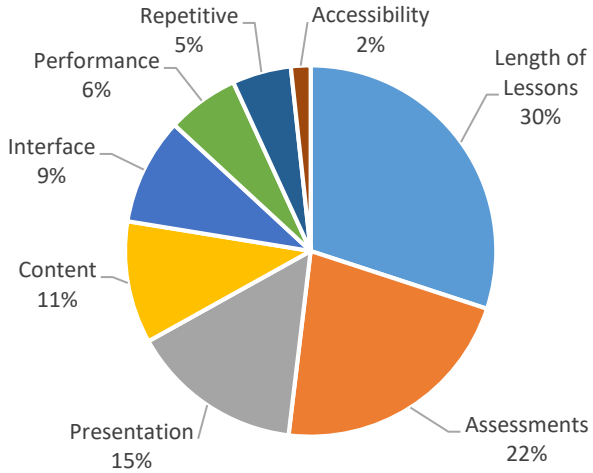


Figure 6. Student responses to the question: "What aspect of the online training system did you find the **least** useful?" (*N*=526)

The top three categories respondents found *most* useful (assessments, presentation and content) corresponded with three of the top four categories they found *least* useful. To explore this discrepancy, the open-ended responses were evaluated more closely, and where respondents provided sufficient explanation, sub-themes within each response category were determined. If a sub-category could not be determined, the response was categorized as "other."

Presentation Category

Among the respondents who found the presentation most useful, 59% (*n*=130) enjoyed the format and visual aspects of the online training. Having the lessons in video format with graphics, images and animations seemed to enhance usability. The second most useful aspect of the presentation was the voice narration of the lesson content, garnering 10% of the responses (*n*=19). While these students appreciated the inclusion of the narration, a majority of the least useful comments pertaining to presentation identified narration as the source of their dissatisfaction. The "boring" or "monotone" nature of the narrator's voice was commented on by 51% of respondents (*n*=49). An additional 11% of respondents (*n*=9) did not directly reference the narration but indicated the lessons as a whole were "boring" or "dull." One could argue that these responses also speak to the narration since it is a significant portion of the presentation. The detailed breakdown of sub-categories related to presentation are shown in Figures 7 and 8.

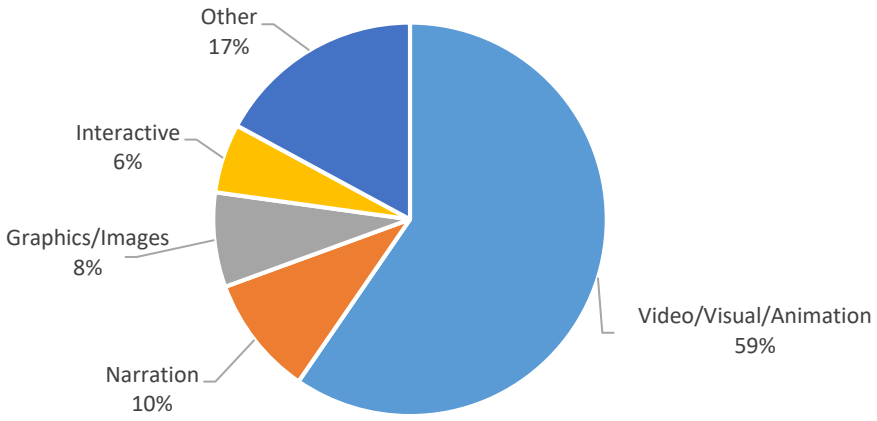


Figure 7. Sub-categories for respondents indicating *presentation* as the **most** useful element of the LMS. (*n*=160)

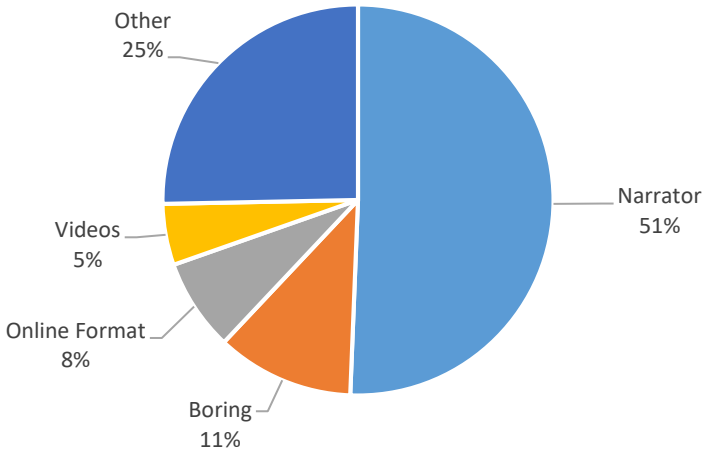


Figure 8. Sub-categories for respondents indicating *presentation* as the **least** useful element of the LMS. (*n*=79)

Content Category

Evaluating the *content* category, 27% (*n*=48) of respondents who found the content most useful identified the level of detail and thoroughness of the information provided, and 10% (n=18) thought it was explained well. Additionally, 18% (*n*=32) of the respondents believed the LMS content served as a good supplement (either preparation or review) to the material presented in class. The respondents who indicated the content was least useful identified the presence of maneuver and flight lessons included throughout the online course. These elements of the LMS were not used in the MSU Denver course curriculum and the LMS did not provide administrative functionality to remove these modules from the main course content display. Some students expressed their dislike of the system as a whole, with 16% (*n*=9) identifying "all of [the content]" least useful. The detailed breakdown of sub-categories related to content are shown in Figures 9 and 10.

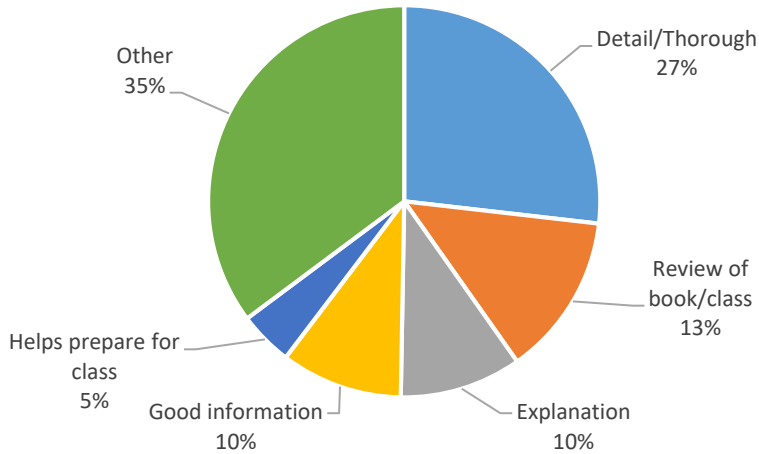


Figure 9. Sub-categories for respondents indicating *content* as the **most** useful element of the LMS. (*n*=179)

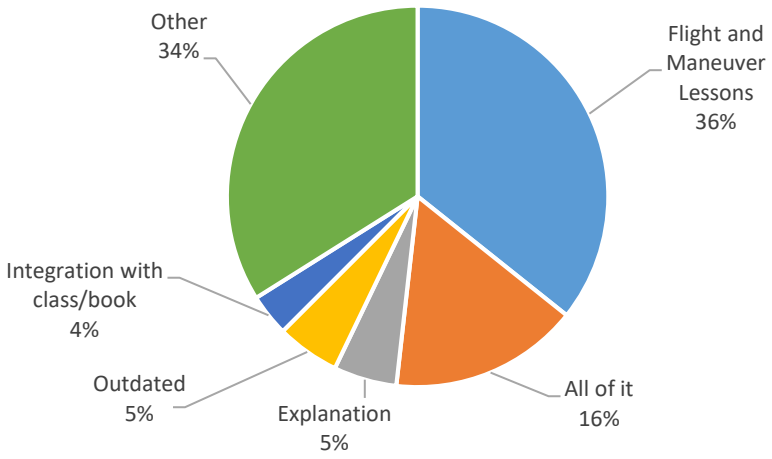


Figure 10. Sub-categories for respondents indicating *content* as the **least** useful element of the LMS. (*n*=56)

Assessment Category

Detailed results within the *assessment* category primarily appear to indicate differences with instructor facilitation of the course and general student preference towards assessments. Among the students who found the assessments least useful, 14% (*n*=16) were unable to review the questions answered correctly and incorrectly on the exams. While this functionality does exist in the LMS, the interface does not didactically lead the user to the review, so many students were unaware of this feature. For students who were aware of this functionality, either because their instructor demonstrated it in-class or they came across it on their own, 16% (*n*=25) found it to be the most useful element of the LMS. Other themes found among students who found assessments most useful included short, low-stakes, practice exams in the lesson (13%, *n*=19), the ability to re-take failed exams (11%, *n*=17), and the frequency of exams (11%, *n*=16). Among students who found the assessments least useful, 17% (*n*=19) identified the frequency of exams, 12% (*n*=14) took issue with the exam durations, and 9% (*n*=10) found the exams too difficult. The detailed breakdown of sub-categories related to assessments are shown in Figures 11 and 12.

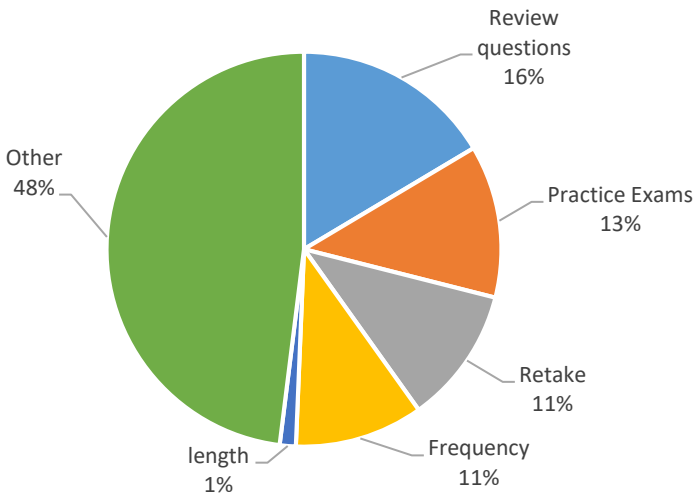


Figure 11. Sub-categories for respondents indicating "assessments" as the **most** useful element of the LMS. (*n*=152)

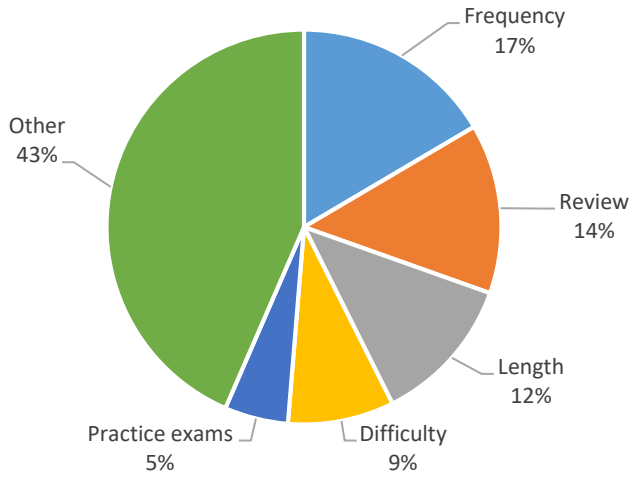


Figure 12. Sub-categories for respondents indicating "assessments" as the **least** useful element of the LMS. (*n*=115)

Likert-item Survey Statement Results

From the 713 student responses to the question, "I would like to see more aviation classes adopt an online training system," 35% (*n*=252) agreed with this statement, 32% (*n*=228) neither agreed nor disagreed, and 33% (*n*=233) disagreed (see Figure 13). In addition, of the students who agreed with this statement, only 6% (*n*=45) strongly agreed, while of the students who disagreed, 14% (*n*=102) strongly disagreed. Given the ordinal nature of Likert-item data, it is not possible to quantify to what degree strongly disagreeing and strongly agreeing differs from disagreeing and agreeing, respectively (Cooper & Johnson, 2016). What can be inferred, however, is that of the students who disagreed with the statement in Figure 13, a larger percentage felt strongly about it compared with those students who were in agreement.

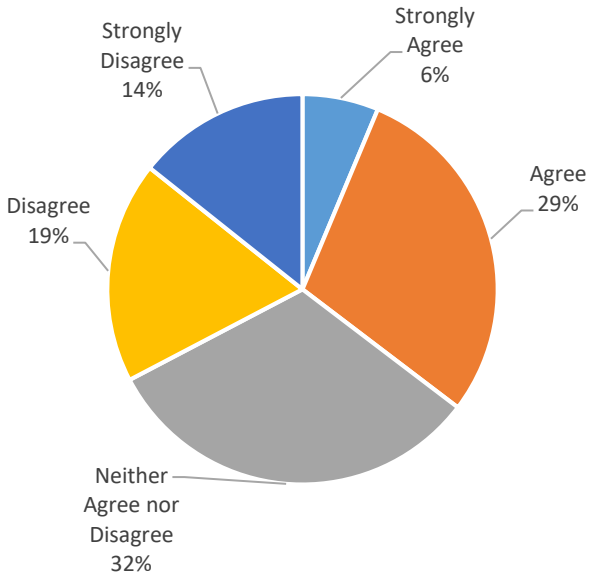


Figure 13. Student responses to the statement: "I would like to see more aviation courses adopt an online training system." (*N*=713)

Of the 616 student responses to the question, "I prefer to use the online training system rather than the textbook," 40% (*n*=249) agreed with this statement, 23% (*n*=143) neither agreed nor disagreed, and 36% (*n*=224) disagreed (see Figure 14). Once again, the number of students strongly disagreeing (16%) exceeded the number of students strongly agreeing (10%).

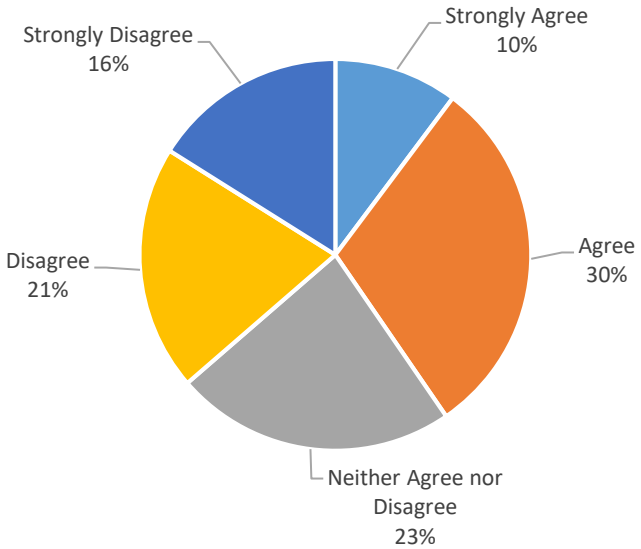


Figure 14. Student responses to the statement: "I prefer to use the online training system rather than the textbook." (*N*=616)

Of the 702 student responses to the SUS question, "I believe the online training system helps me better understand the course material," 66% (*n*=458) agreed with this statement, 18% (*n*=126) neither agreed nor disagreed, and 17% (*n*=118) disagreed (see Figure 15). In a reversal, students felt more strongly in agreement to this statement with 16% (*n*=109) strongly agreeing and only 4% (*n*=31) strongly disagreeing.

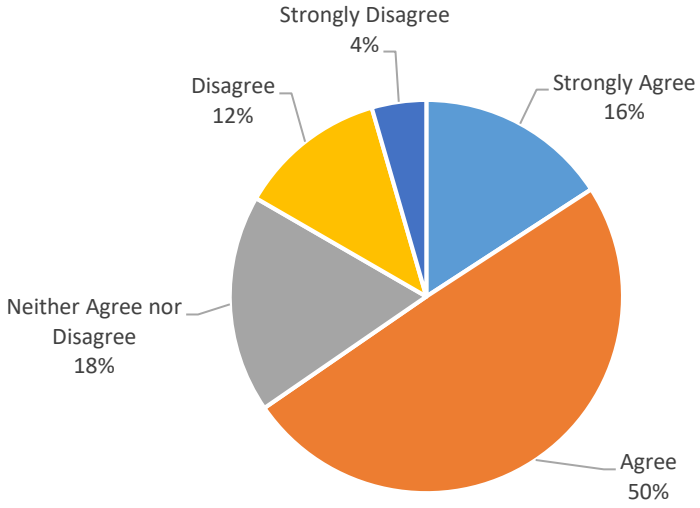


Figure 15. Student responses to the statement: "I believe the online training system helps me better understand the course material." (N=702)

Finally, of the 616 student responses to the SUS question, "I found the various ground lessons in this system were well integrated with the course," 75% (*n*=461) agreed with this statement, 16% (*n*=100) neither agreed nor disagreed, and 9% (*n*=55) disagreed (see Figure 16). Similar to the previous question, students generally felt more strongly in support of this statement, with 16% (*n*=100) strongly agreeing and only 3% (*n*=19) strongly disagreeing.

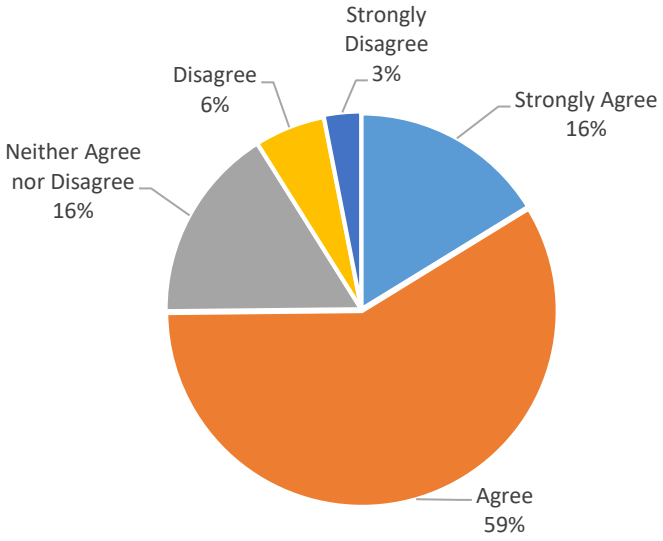


Figure 16. Student responses to the statement: "I found the various ground lessons in this system were well integrated with the course." (*N*=616)

Discussion

The results of the survey suggest a lack of resounding user satisfaction with the LMS by the student group, but do point to areas of improvement that can be made in the course experience. Students showed support for the use of the LMS as a means of improving their understanding of the course material. In this regard, they considered the material to be well

integrated into the course as a whole. Conversely, the student response seemed to also indicate a preference for not applying the use of an LMS to other courses in the program. This sentiment may be rooted in the out-of-pocket expense to access the online content. Some open-ended written responses indicate a dissatisfaction with the expense of a third-party solution. In addition, the lack of administrative tools to customize the online content access meant that students could view ancillary content that was not required by the course syllabus.

Some of the survey feedback highlighted differences with individual instructor implementation of the learning management system in the course. Instructors facilitating the surveyed course sections had previous experience with the course content and delivery in more traditional in-class environments. However, the blended learning format were relatively new, so there may have been a tendency to revert to conventional presentation methods during the scheduled class sessions. Student comments indicating that the online material was "redundant" with their time spent in class suggest that some instructors were not fully implementing a blended learning approach. In addition, the responses indicating the online content served as a good "review of the class" suggest some students were viewing content following the associated in-class sessions instead of prior to it, as was intended. Although the blended learning strategy was not mandated in the course curriculum, the intent of the LMS was, in part, to provide instructors with a framework to explore this approach. Instructors teaching these courses, however, ultimately decide how to implement the online tools in their classes. These factors, taken together or separately, could be a strong contributing factor to the survey results summarized above.

Because this study was designed as a case study, it remains as a future exercise to design a standard curriculum for these courses to take advantage of the concepts of the blended learning environment. This includes education and guidance for instructors who teach these courses, and the development of standard classroom activities to apply the concepts presented in the online portion of the course to real-world scenarios. The results of survey questions to measure the overall satisfaction levels and student attitudes on usability of the LMS could be analyzed by section (i.e., individual instructor) and then correlated with the in-class assignments and activities developed for those sections. It is reasonable to assume that patterns would emerge from the data that show differences among student perceptions of the qualities of the online system that can be related to the use of the standardized materials provided to both help simplify the use of the system and reinforce the learning experience on the part of the student.

Where the data from this study have been most influential has been in the development of in-house content as an alternative to an offering from the third-party provider. The shift to in-house content will benefit the Department's objectives by allowing more control over the content of the material and the delivery mechanism, as well as the delivery schedule. Further, it will benefit students by being distributed free of charge through the University's supported learning management system (Blackboard), helping to reduce out-of-pocket costs. Additionally, it will allow the integration of OER texts from the Federal Aviation Administration and other sources to support the online learning and in-class content. The themes identified in the data for this survey have already begun shaping the format of in-house content for other course offerings at MSU Denver (*Commercial Flight Operations* and *Aviation Weather*), spanning various course formats (online and in-person). Following stabilization of these course formats, additional studies are

planned to compare their results to this study and evaluate user perceptions with more targeted and affordable content.

The aviation students surveyed in this study identified the overall format of the lessons, including video, graphics and images in lieu of static text to be useful features of the online training. Additionally, voice narration of the content seemed generally well received, but care should be taken to select narration with acceptable inflection or enthusiasm, and limit the length of lessons to keep it from seeming monotonous. Different narrator voices and/or having the ability to mute the narration altogether are features that could also address these student concerns. If selecting a commercially available system, consideration should also be given to the complete package being offered. Offerings that contain material not utilized in the coursework should be avoided when possible to avoid the impression among students that they are paying for content from which they receive little to no value. Administrative tools that allow customization of the online course design to meet the specific needs of the class curriculum should also be available.

Conclusion and Future Considerations

The results of this case study reveal interesting and valuable information regarding the continued use of the LMS as the course content delivery platform for aviation coursework. There are limitations to this research that have been identified. Limitations include the lack of significant historical data of LMS environments that have been evaluated using SUS, the inability to make comparisons with existing research studies, and limitations consistent with using a case study methodology.

Discovered during the review of the literature, the lack of substantial research studies using SUS survey techniques of aviation student attitudes and satisfaction with LMS learning environments did not provide a foundation for developing the data collection strategies. This limitation also did not allow for meaningful comparison of this study's data to previous research study data. While not substantial, these limitations restrict comparisons and interpretations to the data sets collected and associated with this study's efforts. Additionally, given the case study methodology applied, the data collected does not allow for generalization to a given population, rather only for the study's participants and the aviation students of the program as a whole. However, this is wholly consistent with case study research and actually can be considered a benefit of this study's results.

There are several good areas for future research and exploration. These areas include continued survey of student attitudes and satisfaction with LMS environments, comparisons of current third party LMS and custom in-house LMS environments, potential improvements in designing blended learning activities to facilitate student use of LMS course content, and expanding future studies to include supplementing the SUS survey with additional survey data to include qualitative data sets, and the development of surveys that could produce data sets that may address student attitudes and satisfaction with the efficiency of learning via LMS learning environments.

As this study was designed as a case study approach, the data results offered good insight into students' attitudes and satisfaction regarding the use of the LMS environment. This study identified both positive aspects of using the LMS, as well as aspects of the LMS environment that could be improved upon. These discoveries serve well for the continued use of the LMS environment in a blended learning approach, for areas where the LMS environment could be enhanced and perfected to improve the students' satisfaction, as well as moving forward in designing new in-house LMS-based content for other aviation course content for the Department's programs.

References

Bangor, A., Kortum, P. T., & Miller, J. T. (2008). An Empirical Evaluation of the System Usability Scale. *International Journal of Human-Computer Interaction, 24*(6), 574-594. https://doi.org/10.1080/10447310802205776

Brooke, J. (1996). SUS: A "quick and dirty" usability scale. In P. W. Jordan, B. Thomas, B. A. Weerdmeester, & I. L. McClelland (Eds.), *Usability evaluation in industry* (pp. 189–194). London, UK: Taylor & Francis.

Cooper, D., & Johnson, T. P. (2016). How to use survey results. *Journal of the Medical Library Association, 104(2).* https://dx.doi.org/10.3163%2F1536-5050.104.2.016.

Dusenbury, M.J., & Olson, M.R. (2019). The impact of flipped learning on student academic performance and perceptions. Collegiate Aviation Review International, 37(1), 19-44. Retrieved from http://ojs.library.okstate.edu/osu/index.php/CARI/article/view/7765/7189

International Organization for Standardization. (1998). Ergonomic requirements for office work with visual display terminal (VDT's)–Part 11: Guidance on usability (ISO 9241–11(E)). Geneva, Switzerland.

Kearns, S. (2010). E-Learning in Aviation. London: Routledge.

Kearns, S., T. Mavin, & S. Hodge (2016). Competency-based education in aviation: exploring alternate training pathways. London: Routledge.

Kille, T., P. Bates & P. Murray. (2015). Peer Observation in the Online Learning Environment: The Case of Aviation Higher Education. In C. Klopper and S. Drew (eds.), *Teaching and Learning for Teaching*. Retrieved from https://link.springer.com/chapter/10.1007%2F978-94-6300-289-9_6#page-1.

King, G., & Duburguet, D. (2013). *Implementing an Online Learning Management System in a Private Pilot Ground School.* Paper presented at the 11th Annual Oklahoma Aerospace Education Research Symposium, Oklahoma State University.

Kortum, P. T., & Bangor, A. (2013). Usability Ratings for Everyday Products Measured with the System Usability Scale. *International Journal of Human-Computer Interaction*, *29*, 67-76. https://doi.org/10.1080/10447318.2012.681221.

Krzywinski, M. (2014). Visualizing samples with box plots. 2014. *Nature Methods,* 11(2), pp. 119-120. Retrieved from https://www.nature.com/articles/nmeth.2813.

Mahnegar, F. (2012). Learning Management System. *International Journal of Business and Social Science*, 3(12) [Special Issue – June 2012]. Retrieved from http://ijbssnet.com/journals/Vol_3_No_12_Special_Issue_June_2012/14.pdf.

Means, B., Toyama, Y., Murphy, R., & Baki, M. (2013, March). The Effectiveness of Online and Blended Learning: A Meta-Analysis of the Empirical Literature. *Teachers College Record, 115*. Retrieved from https://www.sri.com/sites/default/files/publications/effectiveness_of_online_and_blended_learning.pdf.

Millard, E. (2012, December). 5 Reasons Flipped Classrooms Work: Turning Lectures Into Homework to Boost Student Engagement and Increase Technology-Fueled Creativity. *University Business*, 26.

Neal, J.G., & Hampton, S. (2016). Developing a challenging Online Doctoral Couse Using Backward and Three-Phase Design Models. *Journal of Aviation/Aerospace Education & Research* 25(2). https://doi.org/10.15394/jaaer.2016.1686

Orfanou, K., Tselios, N., & Katsanos, C. (2015). Perceived usability evaluation of learning management systems: Empirical evaluation of the System Usability Scale. *The International Review of Research in Open and Distributed Learning,* 16(2). https://doi.org/10.19173/irrodl.v16i2.1955

Sauro, J. (2011). SUStisfied? Little-Known System Usability Scale Facts. *User Experience Magazine, 10*(3). Retrieved from http://uxpamagazine.org/sustified/.

Tucker, B. (2012, Winter). The Flipped Classroom: Online Instruction at Home Frees Class Time for Learning. *Education Next*, 82. Retrieved from https://www.educationnext.org/the-flipped-classroom/.

Collegiate Aviation Review International

Volume 37 | Issue 2 Peer-Reviewed Article #4

6-27-2019

Analysis of Low-Time Pilot Attitudes in University Aviation Association Member Flight Schools

Mark T. Scharf
Embry-Riddle Aeronautical University

James D. Cross
University of Colorado

Hazardous attitudes, such as antiauthority, impulsivity, invulnerability, macho, and resignation, may increase the risk of accident or incident in aviation. Hazardous attitudes is an overarching term, based on different perceptions and behaviors, which may negativity affect aeronautical decision making, and therefore safety, in pilots. The Aviation Safety Attitudes Scale, addresses attitudes in three areas (Self-Confidence, Risk Orientation, and Safety Orientation), was given to 302 low-time pilots (fewer than 250 hours of flight time). The purpose of this quantitative, survey research was to determine the potential hazardous attitudes of flight school students. Factorial Analysis revealed differences in three areas among the sample: Certification by Number of hours flown in previous 90 days interaction on Safety Orientation was overall statistically significant, $F(2,296)=6.333$, p=.002; Certification by Gender integration on Risk Orientation was overall statistically significant, $F(1,294)=4.48$, $p=.035$; and Gender by Certification interaction on Self-Confidence was overall significant, $F(1,294)=10.324$, $p=0.01$. The researchers concluded that although the overall hazardous attitudes of pilots are similar, there may be additional opportunities for instructors and curriculum developers to continually reinforce hazardous attitude awareness.

Recommended Citation:
Scharf, M.T. & Cross, J.D. (2019). Analysis of Low-Time Pilot Attitudes in University Aviation Association Member Flight Schools. *Collegiate Aviation Review International*, 37(2), 58-77. http://dx.doi.org/10.22488/okstate.19.100216

Safety is regarded as a key important element in aviation. To ensure passenger and staff safety, modern aviation lines engage in a number of strategies, quality assurance, and prevention programs to ensure the highest safety standards. One of the safety factors associated with an increased risk of incident is a phenomenon known as hazardous attitudes (Blakaj et al., 2018; Molesworth & Chang, 2009). Hazardous attitudes toward safety can be characterized as an umbrella term which refers to a number of individual perceptions and behavioral strategies which may cloud decision making in pilots and thus lead to incidents (Lee & Park, 2016). Please see Table 1.

Table 1
Description of the Five Hazardous Thoughts within Aeronautical Decision Making

Name	**Description**
Antiauthority	"Don't Tell Me What to Do"
Impulsivity	"Do Something Quickly!"
Invulnerability	"It Won't Happen to Me"
Macho	"I Can Do It"
Resignation	"What's the Use?"

Note. The five most common hazardous attitudes within aviation. Adapted from "AC 60-22" by Federal Aviation Administration, 1991, Appendix 4. Retrieved from https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_60-22.pdf

The original documentation of hazardous thoughts and attitudes was presented in the Federal Aviation Administration (FAA) (1991) Advisory Circular (AC) 60-22. These five hazardous thoughts are still today the foundation of aeronautical decision making, and are the basis for Hunter's Aviation Safety Attitude Survey (ASAS), presented in this paper.

Hazardous thoughts, attitudes, and actions are all part of the safety mindset and culture. Hunter's (2005) original Aviation Safety Attitude Survey used the terms interchangeably. For example, Hunter's ASAS measures hazardous attitude responses to questions regarding self-confidence, risk taking, and safety orientation. Since attitude is a fundamental part of a safety mindset, and to avoid confusion, the term *hazardous attitude* will be used throughout this paper.

Not all hazardous attitudes are always bad. Attitudes of *macho* and *resignation* can, in limited situation, be positive attributes. A controlled use of "I can do it" can help build confidence and limited use of "What's the use?" can help pilots make safer decisions by not attempting to fly into hazardous weather. For the majority of time, however, hazardous thoughts and attitudes such as being macho, antiauthority, resignation, impulsive, and invulnerable are believed to contribute to road traffic incidents (Blakaj et al., 2018) and endanger patient`s lives within clinical and sport settings (Bruinsma, Becker, Guitton, Kadzielski, & Ring, 2015; Cogburn, Horton, & McNeil, 2017). Importantly, Lee and Park (2016) pointed out that despite its importance, the problem of hazardous attitudes and approaches towards its assessment are poorly understood.

Literature Review

Many studies in aviation (Lee & Park, 2016; Wang, Zhang, Sun, & Ren, 2018) and other industries (Blakaj et al., 2018; Bruinsma et al., 2015; Cogburn et al., 2017) have been researching the problem of hazardous attitudes. Prior to further analyzing the concept and its assessment, it is important to define its meaning. Lee and Park (2016) offered the following definition of the term hazardous attitudes: "…the tendencies of individuals to react to stimuli in such a way that risks increase in a given situation or event" (p. 70). Hazardous attitudes are a complex multi-facet phenomenon, associated with a number of negative outcomes across a variety of professional contexts. For example, Blakaj et al. (2018) reported that hazardous attitudes are associated with an increased risk of making wrong decisions regarding patient`s radiation treatment in oncology.

Hazardous attitudes can have a profound impact on aeronautical decision-making process, self- reported incidents, and crew resource management. Most importantly, different hazardous attitudes such as *confidence* may make pilot's assessment of risks and difficult situation blurred and cause them to perceive such situations as less risky than they actually are (Hyde & Cross, 2018). Lee and Park (2016) highlighted that hazardous attitudes impact how the pilots perceive their own abilities to handle complex situations, thus altering decision-making process.

According to the evidence provided by Qi, Lai, and Jia (2018) and Lee and Park (2016), hazardous attitudes can be effectively changed via educational and training interventions. Importantly, hazardous attitudes can be viewed as personal motivational tendencies of pilots which impact their judgement and ability to make sound and safe decisions (Qi et al., 2018). The first step in addressing hazardous attitudes is identifying them and recognizing them as a problem. A number of assessment tools have been developed to measure hazardous attitudes among pilots. One of the most widely recognized tools is the Aviation Safety Attitude Scale developed by Hunter (1995).

Wang et al. (2018) conducted a mixed-method research to understand the relationship between cognitive variables and risky flight behaviors among the population of airline transport pilots. The researchers conducted one-way ANOVA and correlation tests to quantify the relationships between the variables, and the concept of risky pilots emerged. Three cognitive variables have a strong correlation with a pilot being characterized as a risky one: risk perception, hazardous attitude, and risk tolerance. Wang et al. (2018) concluded that hazardous attitude is correlated with a risk of incidents of unsafe and risky events; moreover, targeted training and educational interventions can help improve and correct pilot`s risky attitudes.

Lee and Park (2016) performed a quantitative cross-sectional study of hazardous attitudes among passenger airline pilots of Korean and non-Korean origin. The goal of the study was to identify any differences in attitudes and behavioral patterns between the two groups of pilots (n=147). A t-test and ANOVA statistical analyses were used to compare pilots` attitudes and behaviors using a 56-item questionnaire, which included the questions from the ASAS. According to the obtained results, there were significant differences in the conceit factor was observed ($p < .001$) between Korean and non-Korean pilots. The average value for the conceit

factor was higher for the non-Korean pilots. Interestingly, regardless of cultural background, pilots who had less than 1,000 and more than 10,000 hours of flight time experienced significantly fewer tendencies towards hazardous attitudes. The limitation of this research is that Lee and Park (2016) did not use any of the widely adopted hazardous attitude measurement tools, and instead chose to create their own instrument by integrating the elements of the ASAS and other questionnaires.

A number of demographic factors must be taken into account when attempting to measure hazardous attitudes and risky behaviors among pilots. One important characteristic is gender of the pilot. Furedy (2019) conducted a quantitative study to identify whether significant differences in hazardous attitudes exist between male and female pilots. Rather than adopting the ASAS tool, Furedy (2019) instead adopted the New Hazardous Attitudes Scale (the New-HAS) questionnaire. The New-HAS is a self-assessment tool developed by Hunter (2005), and similarly to the ASAS, is based on Likert-scale responses. As opposed to the ASAS, the New-HAS contains a total of 88 simple declarative statements, which the respondents have to evaluate. According to the obtained results, female pilots had significantly higher hazardous attitude scores in the more advanced levels of training suggesting that gender differences indeed exist.

A number of experts have voiced an opinion that flight accidents are complex events, and although it is important to consider human error, this factor alone rarely causes a fatal incident (Qi et al., 2018). Dismukes, Berman, and Loukopoulos (2016) conducted a retrospective cross-sectional research to understand the relationship between different factors leading to incidents and fatal events and concludes that conducted expertise often operates using limited evidence. Dismukes et al. (2016) warned against using pilot hazardous attitude testing as a sole predictor of safety risks and incidents. As discussed above, hazardous attitudes depend on a number of factors, including pilot`s gender, level of training and professional experiences. Therefore, such attitudes are prone to change and should be assessed systematically.

Problem

Safe aircraft operations occur from a combination of skill and pilot attitude. Skill is traditionally measured and evaluated during training and check rides. Pilot attitudes have no pre-defined times to be evaluated. Although instruments such as the ASAS have been used successfully with higher-time pilots (more than 250 flight hours) by researchers such as Hyde and Cross (2017) and Lee and Park (2016), assessment of lower-time pilot (250 or fewer flight hours) attitudes is lacking. The 250-hour delineation occurs because a pilot with fewer than 250 hours is traditionally considered either a pilot flying only for personal pleasure or a pilot working to obtain certification to fly for compensation. The problem is the lack of data regarding low-time pilot’s attitudes toward safety. Understanding and establishing correct safety attitudes early in a pilot’s career will help ensure safer long-term operations.

Purpose

The purpose of this quantitative, survey research was to determine if significant differences existed in potential hazardous attitudes of flight school students. Although prior

research has analyzed hazardous pilot attitudes, little research has been conducted to specifically determine attitudes of low-time pilots in university aviation flying programs. This research helps fill a gap in the literature as an accurate assessment of low-time pilots.

Method

This research employed a quantitative, survey method to determine the potential hazardous attitudes of current flight school students. There are approximately 559 non-university (independent) flight schools within the US (FAA Flight Schools, 2019). An independent flights school's pilot enrollment can continuously fluctuate between just a few students up to hundreds of students for a large school. Attempting to survey all student pilots within this group was impractical due to the difficulty in contacting each flight school individually.

One group, the University Aviation Association (UAA), provided an ideal setting to conduct purposive sampling. The UAA is an organization comprised of 236 schools, which include 127 flight programs, located in the US and eight foreign countries. The UAA mission is "a professional association and unifying voice for promoting and furthering aviation education as a collegiate academic discipline" (UAA, 2019, p. 1). The UAA is the leader in coordinating, guiding, and providing safety and curricula information for aviation schools. It is estimated there are approximately 3,000 flight students within the UAA system, which the authors considered representative of all collegiate flight schools. Pilot training in university settings offer optimal purposive sampling opportunity because of the number of pilots who fly under standardized curriculum, as opposed to pilots who attend individual flight schools outside of a university setting, moreover, the results can be used to validate and update current training programs.

Research Question

RQ: Do UAA flight school students exhibit a similar extent of hazardous attitudes, based on the attributes of age, gender, highest level of certification, possession of an instrument rating, total flying time, and flight time, while in flight school training?

Hypothesis

$H1_a$: There is a significant difference in hazardous attitudes reported by UAA students based on the six attributes stated above within the area of Self-Confidence.

$H1_0$: There is no significant difference in hazardous attitudes reported by UAA students based on the six attributes stated above within the area of Self-Confidence.

$H2_a$: There is a significant difference in hazardous attitudes reported by UAA students based on the six attributes stated above within the area of Risk Orientation.

$H2_0$: There is no significant difference in hazardous attitudes reported by UAA students based on the six attributes stated above within the area of Risk Orientation.

$H3_a$: There is a significant difference in hazardous attitudes reported by UAA students based on the six attributes stated above within the area of Safety Orientation.

$H3_0$: There is no significant difference in hazardous attitudes reported by UAA students based on the six attributes stated above within the area of Safety Orientation.

Procedure

This research was approved by the Embry-Riddle Aeronautical University IRB, protocol #19-113. A request for participation was sent to all UAA member schools via the UAA newsletter. The request was for low-time pilots (fewer than 250 hours) to complete the ASAS. Using G*Power, a minimum sample size of 270 was sought. A total of 302 survey were completed.

Instrument

The Aviation Safety Attitudes Scale was used for this research (see Appendix). These items are designed to measure pilot's attitude towards various hazardous attitudes, and in turn, aviation safety issues. The developed scale contains two items to measure the five thought patterns identified as hazardous by the FAA, including *macho*, *antiauthority*, *impulsive*, *invulnerable*, and *resignation*. The remaining survey items were designed to address other possible attitudes associated with risky flying or safety concerns.

The ASAS categorized the 27 hazardous attitudes into three general areas: Self-Confidence, Risk Orientation, and Safety Orientation. Hunter created the 27-question, Likert-style survey to directly assess the five hazardous attitudes originally presented from Table 1. Fourteen of the statements address self-confidence, eight statements address risk orientation, and four statements address safety orientation. One statement addressed technical knowledge, but not attitude. This question, #14, was designed to give feedback on the student's perception of the accuracy of the forecasts, but was not considered part of the hazardous attitudes. The individual statements are combined within the three categories to give a representative description of an individual's attitude toward self-confidence, risk orientation, and safety orientation.

Hunter (2005, 2015) assessed both the validity and reliability of the ASAS. According to the performed retrospective analysis, within the context of the ASAS scale, a total of 14 out of 27 observed correlations between hazardous attitudes and risky behaviors were statistically significant. High levels of significance was observed in relation to the ASAS subscale of Risk Orientation with 7 out of 10 validation measures were significantly correlated. According to Hunter (2005), such results indicate that "… those pilots with the greatest risk orientation also believed that the outcome of situations was largely due to external influences beyond their control" (p.37). Hunter (2005) has also demonstrated a relationship between the Risk Perception, Risk Tolerance, and Self-Confidence scales: pilots with the highest level of self-confidence also judged the flight situation to be less risky when compared to other pilots. Overall, the ASAS tool has a high internal and external reliability (Hunter, 2015). This study also demonstrated that the ASAS tool has a high level of validity as a number of studies adopt this tool to evaluate hazardous attitudes and risky behaviors among pilots.

Hunter's grouping of the questions, into the three categories of Self-Confidence, Risk Orientation, and Safety Orientation, are presented in Tables 2 and 3.

Table 2
Individual Statements as Grouped by Area

	Self-Confidence	Risk Orientation	Safety Orientation
Statements	2, 4, 6, 7, 8, 9, 10, 13, 18, 20, 21, 22, 23, & 25	1, 5, 12, 16, 19, 24, 26, & 27	3, 11, 15, &17

Table 3
Numerical Statements as Grouped by Area

		Self-Confidence	Risk Orientation	Safety Orientation
Statement				
1	I would duck below minimums to get home.		X	
2	I am capable of instrument flight.	X		
3	I am a very careful pilot.			X
4	I never feel stressed when flying.	X		
5	The rules controlling flying are much too strict.		X	
6	I am a very capable pilot.	X		
7	I am so careful that I will never have an accident.	X		
8	I am very skillful on controls.	X		
9	I know aviation procedures very well.	X		
10	I deal with stress very well.	X		
11	It is riskier to fly at night than during the day.			X
12	Most of the time accidents are caused by things beyond the pilot's control.		X	
13	I have a thorough knowledge of my aircraft.	X		
14	Aviation weather forecasts are usually accurate.			
15	I am a very cautious pilot.			X
16	The pilot should have more control over how he/she flies.		X	
17	Usually, your first response is the best response.			X
18	I find it easy to understand the weather information I get before flights.	X		
19	You should decide quickly and then make adjustments later.		X	
20	It is very unlikely that a pilot of my ability would have an accident.	X		
21	I fly enough to maintain my proficiency.	X		
22	I know how to get help from ATC if I get into trouble.	X		
23	There are few situations I couldn't get out of.	X		
24	If you don't push yourself and the aircraft a little, you'll never know what you could do.		X	
25	I often feel stressed when flying in or near weather.	X		
26	Sometimes you just have to depend on luck to get you through.		X	
27	Speed is more important than accuracy during an emergency.		X	

Individual questions are aggregated into the above three categories. To offer a more complete analysis, for this research, six demographic variables were included with the survey. Age, Gender, Highest Level of Certification, Possession of an Instrument Rating, Total Flying Time, and Flight Time in the Previous 90 Days were included. Rather than simply analyze the aggregated data as one large sample, including these variables allowed for more-specific analysis where differences existed within the three hazardous areas.

Limitations

The population was limited to students enrolled in UAA flight school programs. Participants were volunteers who agreed to share their time and attitudes about different aspects of safety. While purposeful, these responses may, or may not, be representative for students at non-UAA flight schools.

Results

General Attributes

Six variables were included: Age, Gender, Highest Level of Certification, Possession of an Instrument Rating, Total Flying Time, and Flight Time in the Previous 90 Days. For the *Age* variable, 94% were between the ages of 18-22 years and 6% were between the ages of 23-27 years. For the *Gender variable*, 74% identified as Male, 25 identified as Female, and 1% did not identify a gender. For the *Highest Level of Certification* variable, 68% were Private pilots and 32% were Student pilots. For the *Possession of an Instrument Rating* variable, 28% possessed an instrument rating while 72% did not possess an instrument rating. For the *Total Flying Time* variable, 15% had fewer than 25 hours, 8% had 25-50 hours, 12% had 51-75 hours, 8% had 76-100 hours, 33% had 101-150 hours, 14% had 151-200 hours, and 22% had 201-250 hours. For the *Flight Time in the Previous 90 Days* variable, 14% flew 1-10 hours, 47% flew 11-25 hours, and 39% flew 26-50 hours. See Figure 1 for individual question results.

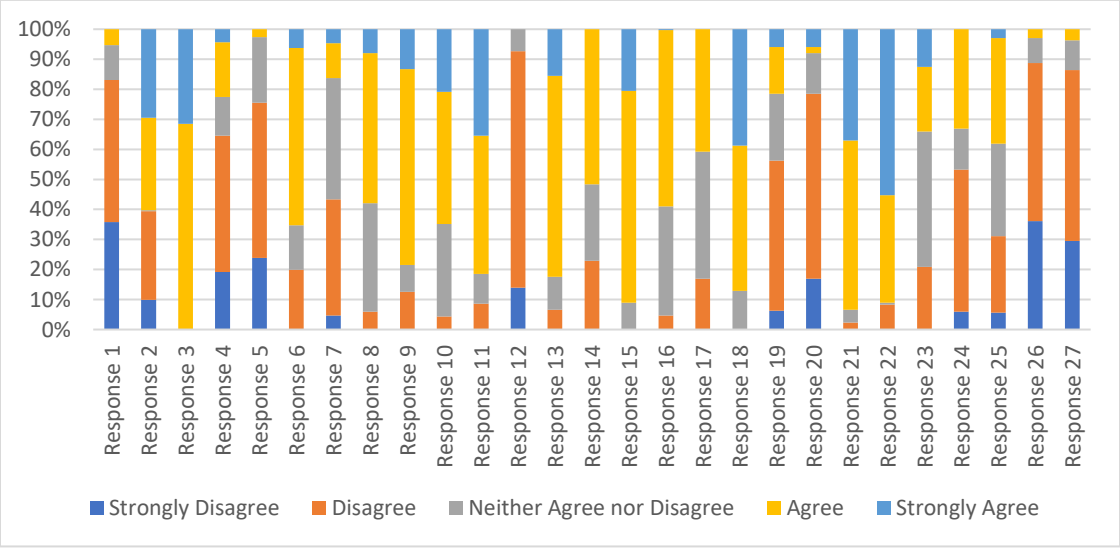


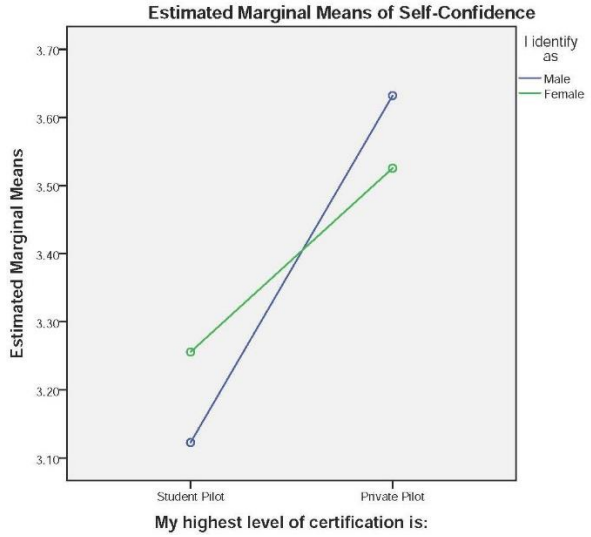
Figure 1. Individual question results. Please see actual survey questions located in the reference section.

Although there were small differences among respondents on each question, pairwise comparisons showed statistically significant differences in three areas:

Self-Confidence

Within *Self-Confidence*, differences were noted in gender and type of pilot certification.

The Gender by Certification interaction on Self-Confidence was overall significant, $F(1,294)=10.324$, $p=.01$. Among student pilots, female pilots scored higher on Self-Confidence ($M=3.256$, $SE=.039$) than male pilots ($M=3.123$, $SE=.036$), $p=.014$. Among private pilots, male pilots scored higher on Self-Confidence ($M=3.632$, $SE=.02$) than female pilots ($M=3.525$, $SE=.049$), $p=.04$. Please see Figure 2.



Pairwise Comparisons					
Dependent Variable: Self-Confidence					
I identify as	My highest level of certification is	My highest level of certification is	Mean Difference	Std Error	Sig.
Male	Student Pilot	Private Pilot	-.509*	.042	.000
	Private Pilot	Student Pilot	.509*	.042	.000
Female	Student Pilot	Private Pilot	-.207*	.062	.000
	Private Pilot	Student Pilot	.207*	.062	.000

*The mean difference is significant at the .05 level

Univariate Tests

Dependent Variable: Self-Confidence

I identify as		Sum of Squares	df	Mean Square	F	Sig.
Male	Contrast	10.462	1	10.462	149.346	.000
	Error	20.596	294	.070		
Female	Contrast	1.336	1	1.336	19.071	.000
	Error	20.596	294	.070		

Each F tests the simple effects of My highest level of certification is: within each level combination of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

Tests of Between-Subjects Effects

Dependent Variable: Self-Confidence

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12.984[a]	3	4.328	61.779	.000
Intercept	2311.316	1	2311.316	32993.046	.000
GENDER	.009	1	.009	.125	.723
CERTIFICATION	7.656	1	7.656	109.288	.000
GENDER * CERTIFICATION	.723	1	.723	10.324	.001
Error	20.596	294	.070		
Total	3628.791	298			
Corrected Total	33.580	297			

a. R Squared = .387 (Adjusted R Squared = .380)

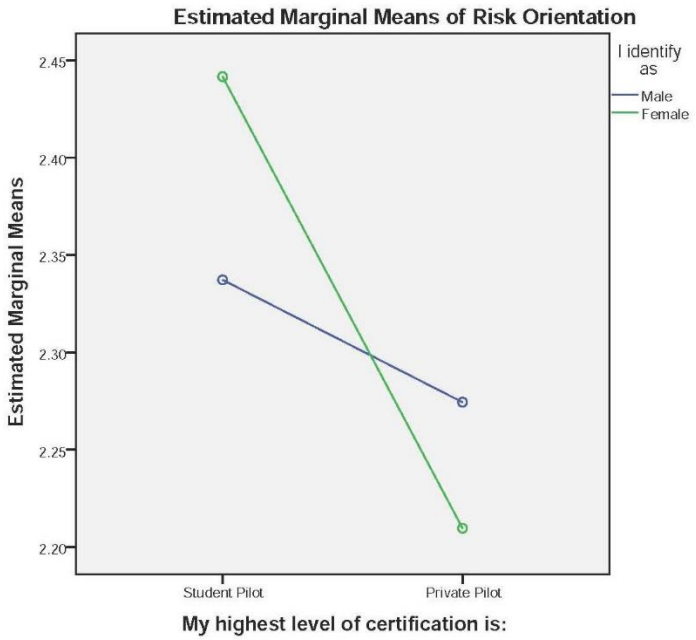
Figure 2. Differences noted between gender and type of pilot certification within the category of Self-Confidence.

Therefore, $H1_0$: There is no significant difference in hazardous attitudes reported by UAA students based on the six attributes stated above within the area of Self-Confidence, is rejected.

Risk Orientation

Within *Risk Orientation*, differences were noted in gender and type of pilot certification.

The Certification by Gender integration on Risk Orientation was overall statistically significant, $F(1,294)=4.48$, $p=.035$. Female student pilots scored higher on Risk Orientation ($M=2.442$, $SE=.042$) than female private pilots ($M=2.21$, $SE=.051$), $p=.001$. Among the female pilots, there was a difference between the attitudes of student pilots and private pilots. Please see Figure 3.



Pairwise Comparisons					
Dependent Variable: Risk Orientation					
I identify as	My highest level of certification is	My highest level of certification is	Mean Difference	Std Error	Sig.
Male	Student Pilot	Private Pilot	.063	.045	.161
	Private Pilot	Student Pilot	-.063	.045	.161
Female	Student Pilot	Private Pilot	.232*	.066	.001
	Private Pilot	Student Pilot	-.232*	.066	.001

*The mean difference is significant at the .05 level

Univariate Tests

Dependent Variable: Risk Orientation

I identify as		Sum of Squares	df	Mean Square	F	Sig.
Male	Contrast	.159	1	.159	1.979	.161
	Error	23.683	294	.081		
Female	Contrast	.988	1	.988	12.263	.001
	Error	23.683	294	.081		

Each F tests the simple effects of My highest level of certification is: within each level combination of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

Tests of Between-Subjects Effects

Dependent Variable: Risk Orientation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.335[a]	3	.445	5.525	.001
Intercept	1082.484	1	1082.484	13438.023	.000
GENDER	.020	1	.020	.246	.620
CERTIFICATION	1.097	1	1.097	13.615	.000
GENDER * CERTIFICATION	.361	1	.361	4.480	.035
Error	23.683	294	.081		
Total	1607.078	298			
Corrected Total	25.018	297			

a. R Squared = .053 (Adjusted R Squared = .044)

Figure 3. Differences noted between gender and type of pilot certification within the category of Risk Orientation.

Therefore, $H2_0$: There is no significant difference in hazardous attitudes reported by UAA students based on the six attributes stated above within the area of Risk Orientation, is rejected.

Safety Orientation

Within *Safety Orientation,* differences were noted in the number of hours flown within the past 90 days and type of pilot certification.

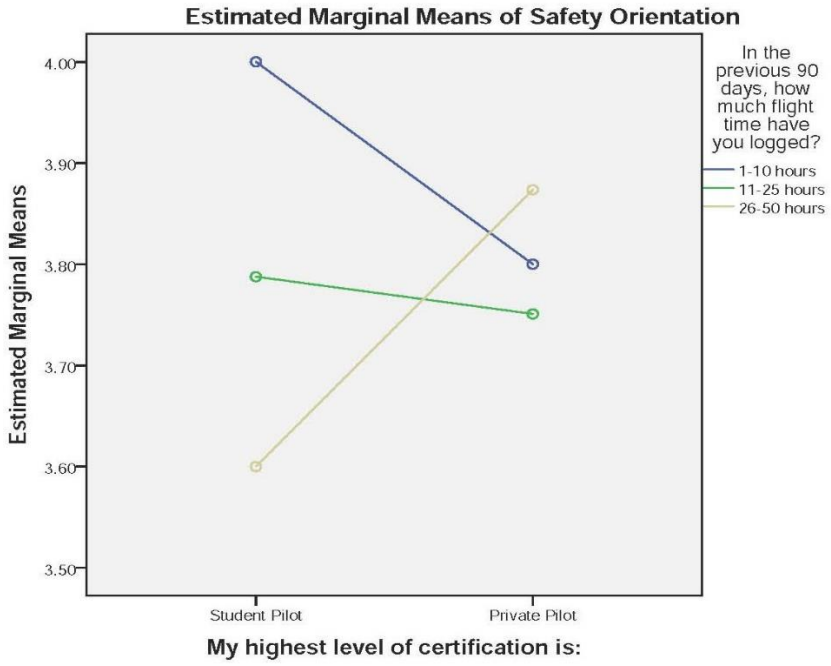
The Certification by Number of hours flown in previous 90 days interaction on Safety Orientation was overall statistically significant, $F(2,296)=6.333$, $p=.002$. Among student pilots, there was no difference between 1-10 and 11-25 hours, but there were statistically significant differences between 1-10 and 26-50 hours as well as 11-25 and 26-50 hours. Among Private pilots, there were no statistical differences between 1-10 hours and 11-25 hours, nor 1-10 and 26-50 hours, but there were statistically significant differences between 11-25 and 26-50 hours. Please see Figure 4.

Pairwise Comparisons

Dependent Variable: Safety Orientation

My highest level of certification is	In the previous 90 days, how much flight time have you logged?	In the previous 90 days, how much flight time have you logged?	Mean Difference	Std Error	Sig.
Student Pilot	1-10 hours	11-25 hours	.212	.131	.105
		26-50 hours	.400*	.151	.008
	11-25 hours	1-10 hours	-.212	.131	.105
		26-50 hours	.188*	.088	.033
	26-50 hours	1-10 hours	-.400*	.151	.008
		11-25 hours	-.188*	.088	.033
Private Pilot	1-10 hours	11-25 hours	.049	.059	.406
		26-50 hours	-.074	.054	.175
	11-25 hours	1-10 hours	-.049	.059	4.06
		26-50 hours	-.123*	.046	.007
	26-50 hours	1-10 hours	.074	.054	.175
		11-25 hours	.123*	.046	.007

*The mean difference is significant at the .05 level



Univariate Tests

Dependent Variable: Safety Orientation

In the previous 90 days, how much flight time have you logged?		Sum of Squares	df	Mean Square	F	Sig.
1-10 hours	Contrast	.176	1	.176	2.193	.140
	Error	23.786	296	.080		
11-25 hours	Contrast	.047	1	.047	.587	.444
	Error	23.786	296	.080		
26-50 hours	Contrast	.807	1	.807	10.041	.002
	Error	23.786	296	.080		

Each F tests the simple effects of My highest level of certification is: within each level combination of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

Tests of Between-Subjects Effects

Dependent Variable: Safety Orientation

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1.395[a]	5	.279	3.471	.005
Intercept	1493.085	1	1493.085	18580.271	.000
TOT_FLYING_90	.343	2	.171	2.131	.120
CERTIFICATION	.004	1	.004	.048	.826
TOT_FLYING_90 * CERTIFICATION	1.018	2	.509	6.333	.002
Error	23.786	296	.080		
Total	4404.320	302			
Corrected Total	25.181	301			

a. R Squared = .055 (Adjusted R Squared = .039)

Figure 4. Differences noted between the number of hours flown within the past 90 days and type of pilot certification within the category of Safety Orientation.

Therefore, $H3_0$: There is no significant difference in hazardous attitudes reported by UAA students based on the six attributes stated above within the area of Safety Orientation, is rejected.

Discussion

There are three areas of statically significant differences for discussion. Each of the three hazardous orientations showed one area of statistically significant differences.

Safety Orientation

Regarding their flight time within the past 90 days, this indicates student pilots who flew the least (1-10 hours) had a higher safety orientation than student pilots who flew more hours

(26-50 hours). Although there were differences in private pilot safety orientation, their differences were much smaller. One probable reason for the differences is that it is quite possible that student pilots who fly less frequently are less comfortable in an airplane, therefore have a higher safety orientation than student pilots who fly more often. Student pilots, who fly more (26-50 hours), have quickly built a basic flying routine, and are more comfortable in the early part of training. As a pilot goes further into training and earns a private pilot's license, the safety orientation increases in every category. Finally, for private pilots, those who flew the most (26-50 hours) had the highest safety orientation (although there were no statistically differences among the private pilot responses).

Risk Orientation

This indicates that female student pilots had a higher risk orientation than female private pilots. Although there were some differences in male student and private pilot risk orientation, their differences were not statistically significant differences From this sample, females had a lower risk orientation (were willing to take on more risk) as they gained more experience. It is possible that as females gained more experience, their perception of the severity of risk decreased. There is always risk in aviation; pilots should be taught to manage risk to acceptable levels. Another possible reason is that, within the sample, the student pilots may have been extremely cautious and, once gaining confidence and certificated as a private pilot, were willing to take more risks and/or reevaluate situations as a lower risk factors than earlier perceived.

Self-Confidence

Overall, self-confidence increase for both males and females as they became private pilots. Males started off with a higher initial score, so the change in their mean score was not as pronounced as the increase in the female's mean score. Sundheim (2013) and Gerdemen (2019) discussed different theories on self-confidence differences in males and females, both noting females, overall, tend to have lower self-confidence. Interestingly, Northwestern Mutual (2017 conducted a financial analysis where females tended to have lower self-confidence than males, but once comfortable in a situation, increased their self-confidence tremendously. This could be a similar situation, both for self-confidence and the previously discussed risk orientation.

Moreover, this also correlated to the driving study conducted by Wayne and Miller (2018). The authors recruited one hundred novice drivers, 50 females and 50 males, who were instructed and evaluated by the same driving instructor. Initially, females were significantly less self-confident in their driving skills than males ($p > .001$), even though there were no gender differences in driving skill rating by the instructor. By the end of the training, there was no difference in male and female self-confidence rating. The authors noted that "female drivers' confidence was positively correlated with hours behind the wheel prior to the lesson—the more hours behind the wheel, the more self-confident the female driver" (Wayne & Miller, 2018, p. 2). Finally, the results of this research are also in agreement with Furedy's (2019) assessment of gender differences in attitude.

Other Considerations

The ASAS is a foundational assessment for determining hazardous attitudes within aviation, however, it is becoming outdated. The ASAS was developed at a time when most aircraft systems were manually controlled. Since the time the ASAS was developed, many fight school use aircraft with autopilots, weather radar, automatic dependent surveillance-broadcast systems, terrain and collision avoidance systems, and many other high-tech devices to assist the pilot. These newer systems may influence the hazardous attitudes first envisioned by Hunter. Although the ASAS is a reliable instrument, and the same five hazardous attitudes are still the foundation of aeronautical decision making, the instrument should include more-advanced concepts such as crew resource management and single-pilot resource management. Newer assessments need to be developed to represent the current environment, including over-reliance on automation and technology, accuracy and displays of different types of weather radar, amount of time spent "heads down" programing computers.

Being associated with a college or university, UAA flight schools tend to have more formalized curriculum and training than is required of private flight schools. The attitudes instilled in a more-structured UAA curriculum may not be representative of independent flight schools. Moreover, although the sample size was sufficient for this research, future studies should include a larger sample size. Since pilots from both UAA and independent flight schools share the sky, it is critical to understand the attitudes of all pilots.

The research question was:

Do UAA flight school students exhibit similar levels of hazardous attitudes, based on the attributes of age, gender, highest level of certification, possession of an instrument rating, total flying time, and flight time, while in flight school training?

As is determined from the analysis, there are statistically significant differences in each of the three areas--Self-Confidence, Risk Orientation, and Safety Orientation--however, only one instance was noted for each area. This indicates that UAA flight school students do exhibit similar levels of hazardous attitudes. Overall, UAA flight school students do share similar views on hazardous attitudes.

Conclusions

Safety attitudes and awareness are a part of every UAA flight school curriculum. The ASAS is one indicator of potentially hazardous attitudes expressed by low-time pilots. Results of this survey showed that, in general, UAA flight school students exhibit similar levels, to each other, of hazardous attitudes while in flight school training, indicating flight schools are successful in helping instill a safety culture within their students. Areas of some differences in Self Confidence, Risk Orientation, and Safety Orientation give us opportunities to create safer attitudes among low-time pilots. There are, however, opportunities for instructors to better understand their student's potentially hazardous attitudes by asking specific questions about their safety orientation, risk orientation, and self-confidence.

Recommendations

There are three areas for flight school instructors and curriculum designers to consider emphasizing in training. First, attitudes should be verbalized as part of the pre-flight briefings. An instructor cannot "know what is inside someone's head," so the most practical way to understand a pilot's attitude is to discuss it. Each lesson's curriculum should dedicate time for the pilot to talk about what aspects of the flight he/she is getting comfortable with and where there is concern. A high safety/risk orientation is desirable, but never to the point of becoming unable to complete the mission. Risk is part of aviation, so pilots need to understand and appropriately manage risk. Second, as a pilot gains additional experience, self-confidence should also increase. The instructor should monitor and acknowledge an appropriate increase in self-confidence. Students should display an appropriate increase in confidence to ensure correct decisions are made, however, this increase needs to be monitored to prevent over-confidence, which can lead to recklessness. One technique is for instructors to emphasize the building-block approach, emphasizing how the next phase of training builds on the good judgement and decision making already demonstrated by the pilot. Third, understand that there may be initial differences in male and female self-confidence. If so, this is considered a normal event. Training for instructors should include information on appropriate increases in self-confidence. More flight time and more opportunities to express good decision making should lead to higher self-confidence.

There are also three recommendations for future research. First, continue to investigate and create attitude assessments that better reflect the current environment and capabilities of flight training. Assessments that include current technology, such as weather radar, hand flying verses using the autopilot, and heads-down orientation versus actively looking outside the aircraft need to be included to get a realistic understanding of current pilots. Although Hunter's ASAS is a foundational document, it may not provide an accurate assessment of the current environment. Next, research should be conducted, with larger samples, to better assess differences, if any, of female pilots. Although studies have shown differences, larger samples sizes should be used to further validate these findings. Finally, these studies should be replicated across all flight schools, not just the UAA flight schools, to create a better understanding of possible systemic changes that need to be made. Studies should be replicated at regular intervals to assess hazardous attitudes and allow instructors and curriculum designers the ability to update their training programs based on current needs. Understanding student and private pilot attitudes allows instructors and curriculum designers better opportunities to continually reinforce safe attitudes.

References

Blakaj, A., Kelly, J. R., Decker, R. H., Ford, E. C., Brown, D. W., Dosoretz, A. P., & Evans, S. B. (2018). Hazardous attitudes: Physician decision making in radiation oncology. *International Journal of Radiation Oncology Biology Physics, 102*(3), S120. https://doi.org/10.1016/j.ijrobp.2018.06.300

Bruinsma, W. E., Becker, S. J., Guitton, T. G., Kadzielski, J., & Ring, D. (2015). How prevalent are hazardous attitudes among orthopaedic surgeons? *Clinical Orthopaedics and Related Research, 473*(5), 1582-1589. doi: 10.1007/s11999-014-3966-2

Cogburn, M., Horton, R., & McNeil, S. E. (2017). Considering a relationship between dysfunctional coaching styles in youth sports and the development of hazardous attitudes in players. *Psychology, 7*(8), 445-452. doi:10.17265/2159-5542/2017.08.004

Dismukes, R. K., Berman, B. A., & Loukopoulos, L. D. (2016). *The limits of expertise: Rethinking pilot error and the causes of airline accidents*. Retrieved from https://humansystems.arc.nasa.gov/flightcognition/Publications/KD_CRMHF_Conference.pdf

FAA Flight Schools. (2019). *Flight schools*. Retrieved from https://www.faaflightschools.com/airplane-schools/

Federal Aviation Administration. (1991). *AC 60-22*. Received from https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_60-22.pdf

Furedy, M. (2019). Gender differences and their relation to hazardous attitudes in pilot training. *The Collegiate Aviation Review International, 37*(1), 73-89.

Gerdemen, D. (2019). How gender stereotypes kill a woman's self-confidence. *Harvard Business Review*. Retrieved from https://hbswk.hbs.edu/item/how-gender-stereotypes-less-than-br-greater-than-kill-a-woman-s-less-than-br-greater-than-self-confidence?cid=wk-rss

Hunter, D. R. (1995). *Airman research questionnaire. Methodology and overall results (No. DOT/FAA/AM-95/27).* Washington, D.C.: Federal Aviation Administration Office of Aviation Medicine. Retrieved from https://apps.dtic.mil/dtic/tr/fulltext/u2/a300583.pdf

Hunter, D. R. (2005). Measurement of hazardous attitudes among pilots. *The International Journal of Aviation Psychology, 15*(1), 23-43. https://doi.org/10.1207/s15327108ijap1501_2

Hunter, D. (2015). *Aviation human factors*. Retrieved from http://www.avhf.com/html/Researcher/ASAS.asp

Hyde, B. H., & Cross, D. S. (2018). The relationship between pilot attitudes and the execution of flight safety checklists. *The Collegiate Aviation Review International, 36*(2). http://dx.doi.org/10.22488/okstate.18.100490

Lee, H. B., & Park, J. W. (2016). Comparative study on hazardous attitudes and safe operational behavior in airline pilots. *Journal of Air Transport Management, 54*, 70-79. https://doi.org/10.1016/j.jairtraman.2016.03.024

Molesworth, B. R., & Chang, B. (2009). Predicting pilots' risk-taking behavior through an implicit association test. *Human Factors, 51*(6), 845-857. https://doi.org/10.1177/0018720809357756

Northwestern Mutual. (2017). *Northwestern Mutual study finds women are more cautious with their finances than men, yet 63% still feel their planning needs improvement*. Retrieved from https://news.northwesternmutual.com/news-releases?item=122404

Qi, F., Lai, W., & Jia, Z. (2018, November). Research on the relationship of safety climate and safety performance in airlines. *Proceedings of the IOP Conference Series: Earth and Environmental Science, 189*(6), 062029. https://doi.org/10.1088/1755-1315/189/6/062029

Sundheim, D. (2013, February 27). Do women take as many risks as men? *Harvard Business Review.* Retrieved from https://hbr.org/2013/02/do-women-take-as-many-risks-as

University Aviation Association. (2019). *About UAA.* Retrieved from https://www.uaa.aero/about_uaa.php

Wang, L., Zhang, J., Sun, H., & Ren, Y. (2018, July). *Risk cognition variables and flight exceedance behaviors of airline transport pilots*. Paper presented at the International Conference on Engineering Psychology and Cognitive Ergonomics. https://doi.org/10.1007/978-3-319-91122-9_57

Wayne, N. L., & Miller, G. A. (2018). Impact of gender, organized athletics, and video gaming on driving skills in novice drivers. *PLOS ONE, 13*(1), e0190885. https://doi.org/10.1371/journal.pone.0190885

Appendix - Aviation Safety Attitude Scale

ItemNumber	Question
1	I would duck below minimums to get home.
2	I am capable of instrument flight.
3	I am a very careful pilot.
4	I never feel stressed when flying.
5	The rules controlling flying are much too strict.
6	I am a very capable pilot.
7	I am so careful that I will never have an accident.
8	I am very skillful on controls.
9	I know aviation procedures very well.
10	I deal with stress very well.
11	It is riskier to fly at night than during the day.
12	Most of the time accidents are caused by things beyond the pilot's control.
13	I have a thorough knowledge of my aircraft.
14	Aviation weather forecasts are usually accurate.
15	I am a very cautious pilot.
16	The pilot should have more control over how he/she flies.
17	Usually, your first response is the best response.
18	I find it easy to understand the weather information I get before flights.
19	You should decide quickly and then make adjustments later.
20	It is very unlikely that a pilot of my ability would have an accident.
21	I fly enough to maintain my proficiency.
22	I know how to get help from ATC if I get into trouble.
23	There are few situations I couldn't get out of.
24	If you don't push yourself and the aircraft a little, you'll never know what you could do.
25	I often feel stressed when flying in or near weather.
26	Sometimes you just have to depend on luck to get you through.
27	Speed is more important than accuracy during an emergency.

Collegiate Aviation Review International

Volume 37 | Issue 2 Peer-Reviewed Article #5

7-18-2019

Depression and Anxiety in Pilots: A Qualitative Study of SSRI Usage in U.S. Aviation and Evaluation of FAA Standards and Practices Compared to ICAO States

Jake Durham
Southeastern Oklahoma State University

Timm Bliss
Oklahoma State University

Before 2010, the Federal Aviation Administration (FAA) did not allow airmen to exercise the privileges of pilot in command (PIC) of an aircraft or obtain a medical certificate if one had been diagnosed with anxiety, depression, and/or taking an SSRI medication. Since 2010, the FAA relaxed its views and certification standards. However, this is not an issue unique to the U.S. The International Civil Aviation Organization (ICAO) and other ICAO States began evaluating airmen suffering from anxiety, depression, and/or taking an SSRI medication in early 2000. ICAO and most ICAO States have identified the need for further research regarding mood disorders and airmen. In addition, ICAO has issued guidance regarding certification standards, though each ICAO State has the authority to set its own standards. While the FAA and the other ICAO States have accepted mood disorders in aviation as a reality, additional work is needed to unify standards within the international aviation community. ICAO States with more stringent standards, may force airmen to seek alternative treatment options and not disclose crucial medical information or seek appropriate treatment options in fear of reprisal. In 2018, a qualitative study was conducted that evaluated FAA medical certification standards for airmen suffering from mood disorders and compared them against medical certification standards of other ICAO State agencies and ICAO recommended practices. This qualitative study also evaluated U.S. pilot perceptions of the certification process, as well as views from a non-aviation medical physician using interviews and survey questionnaires. Responses were compared to current practices and evaluated. Findings from this study concluded that while FAA certification standards may be comparable to other ICAO States, general views regarding agency acceptance of mental health disorders can vary widely across State agencies.

Recommended Citation:
Durham, J., & Bliss, T. (2019). Depression and Anxiety in Pilots: A Qualitative Study of SSRI Usage in U.S. Aviation and Evaluation of FAA Standards and Practices Compared to ICAO States. *Collegiate Aviation Review International*, 37(2), 78-109. http://dx.doi.org/10.22488/okstate.19.100217

Generalized anxiety disorder (GAD) and depression are among the most common mood disorders in the U.S. (Anxiety and Depression Association of America [ADAA], 2016). While there are several sub-categories of each disorder, approximately 6.7 million Americans suffer from GAD, and approximately 15 million are diagnosed with depression (ADAA, 2016). Events that trigger these disorders can be widespread, which can be affected by genetics, stress, social makeup, phobias, and traumatic experiences (ADAA, 2016). The Anxiety and Depression Association of America (ADAA) states that most adults will experience some form of anxiety or depression in their lives (ADAA, 2016).

Approximately 80% of individuals who suffer from one of these disorders never seek diagnosis, and some individuals who are diagnosed never seek treatment options (Healthline, 2017). Transport Canada has concluded that approximately 6% of the population suffers from some form of mood disorder, and this same ratio exists among the pilot population (Transport Canada, 2018). A standard treatment option for those suffering from anxiety or depression is to prescribe a selective serotonin reuptake inhibitor (SSRI) (ADAA, 2016). SSRIs work by altering the chemical makeup of the brain, which changes how serotonin interacts within the neurotransmitters and how messages are sent and received (ADAA, 2016). Approximately 80% to 90% of individuals who are prescribed an SSRI for mood disorders have positive results with the treatment and experience few side effects (ADAA, 2016).

The topic of pilots and mental health is a sensitive issue. Moreover, the Federal Aviation Administration (FAA) has maintained strict guidelines that prevented pilots from exercising the privileges of any license or obtaining a medical certificate for those suffering from, or diagnosed with, anxiety, depression, and/or taking a selective serotonin reuptake inhibitor. U.S. Federal Aviation Regulations regarding mental health in pilots and the use of SSRIs are maintained in Title14 CFR Part 67: Medical Standards and Certification (GPO, n.d.). Since 2010, the FAA has relaxed some of its requirements allowing pilots to use certain SSRIs under the issuance of a medical waiver (FAA, 2010).

Background of the Study

Currently, the FAA approves four SSRI medications for pilot use: (1) Lexapro; (2) Prozac; (3) Celexa; and (4) Zoloft (FAA, 2017a). According to FAA policy (2017a), applicants are required to indicate on their medical application if they are taking an SSRI and whether one has been diagnosed with or has a history of anxiety or depression. An aviation medical examiner (AME) is instructed not to issue a medical certificate (in most cases) and submit the application to the FAA for further review (FAA, 2017a).

After submitting a medical application, the pilot must be monitored and re-evaluated by an appropriate mental health specialist (e.g., psychiatrist) after six months of a consistent single-dose usage of one of the four FAA approved medications (FAA, 2017a). After a six-month demonstration period, a pilot may request a re-evaluation from their psychiatric care physician; a specialist from the FAA Aeromedical Division will evaluate the documentation and grant or deny the request for a medical waiver (FAA, 2017a).

While the certification process was initially lengthy, it has been shortened in recent years. Initially, the medical waiver process required pilots to demonstrate 12 months of consistent SSRI use along with appropriate documentation; however, even with a recent reduction to a six-month evaluation period, there is no guarantee that a medical waiver will be granted. Furthermore, while the FAA has allowed the use of some medications, they still prohibit most SSRIs and other mood-altering medications (FAA, 2017a).

Past and Current Problems

Previously, any pilot who had been diagnosed with or has symptoms of anxiety, depression, and/or taking an SSRI was prohibited from exercising the privileges of an airman certificate and obtaining any class of FAA medical (FAA, 2010). Pilots who had been prescribed an SSRI in the past were required to demonstrate successful discontinued use of the medication for at least 90 days before consideration of a medical certificate was granted (FAA, 2010). The International Civil Aviation Organization (ICAO) and many of its member States have a different approach to SSRI medications and airmen medical certification. Australia, for example, has conducted studies regarding mood disorders, SSRIs, and other treatment options as early as the 1980s and has since approved their pilots to take SSRI medications while continuing to fly (Werfelman, 2008). The Civil Aviation Safety Authority (CASA) of Australia has concluded that pilots taking an SSRI pose no significant safety threat when compared to individuals who do not suffer from a mood disorder (Nowak, 2007).

While the FAA has relaxed its certification standards regarding anxiety and depression, prevalent questions and potential problems remain. Some of these issues include: (1) pilot compliance with FAA standards; (2) pilots not seeking medical help when needed; (3) pilots seeking unauthorized treatment options; (4) how FAA views align with ICAO and other ICAO States; and (5) the SSRI medications currently approved by the FAA.

Pilots and Mental Health

It is estimated that between 10 and 20 million people in the U.S. suffer from some form of anxiety or depression (Stoutt, n.d.). Approximately one in ten men and one in four women will be affected by anxiety or depression at some point in their life (Stout, n.d.). These disorders have become so common that they are often referred to as the common cold of psychiatry, and it is no surprise that pilots are also affected by these mental disorders as well (Stoutt, n.d.).

Often anxiety is associated with intense bouts of fear, and these feelings or threats may be real or imaginary (Lott, & Stenson, n.d.). Often these fears may trigger a reactive response in the form of a panic attack which can be debilitating depending on the severity (Lott, & Stenson, n.d.). Some symptoms of anxiety include excessive worrying, trouble sleeping, headaches, stomach aches, and vomiting (Lott & Stenson, n.d.). These symptoms may cause an individual to avoid certain situations or develop phobias that may interfere with daily life, work, academics, or other social settings (Lott, & Stenson, n.d.). In some cases, pilots have even developed a fear of flying (Bor, Field, & Scragg, 2002).

Depression, the second most common mood disorder, can become more detrimental to pilots due to its potentially debilitating effects (Flight Safety Foundation [FSF], 2001). Depression may be progressive throughout a person's day, and symptoms may become more prevalent (Stoutt, n.d.). Many symptoms of depression include periods of sadness, grief, fatigue, and loss of interest in usual activities (Stoutt, n.d.). A person may also experience loss of appetite, irritability, irrationalism, and even feelings of guilt (Stoutt, n.d.). Depression may also be classified as a form of bipolar disorder (often referred to as manic depression), and symptoms include alternating periods of mania and bouts of depression (FSF, 2001).

Not all mental health issues or psychological problems are easily detectable (Bor at al. 2002). Some symptoms may lay dormant in an individual for years (Bor et al., 2002). Moreover, some symptoms are difficult for mental health professionals to simulate during a professional assessment (Bor et al., 2002). Therefore, it is not reasonable to expect that flight crew members will always be self-aware of underlying problems, and they may often rely on a family member or coworker observations (Bor et al., 2002). Many mental health and personality disorders remain undiagnosed until the individual shows long-term and repeated behaviors that can make it challenging to work or cooperate with others (Bor et al., 2002). The U.S. airline industry, for example, requires pilots to be displaced from their home environment for extended periods (Bor et al., 2002). This may create a dissociation with close relationships that can further affect the pilot's overall mental performance (Bor et al., 2002). However, a stable and productive home life with strong personal relationships may act as a buffer between the added work-related stress (Bor et al., 2002).

In 2015, the case of Germanwings 9525 gained wide-spread international media coverage after the plane crashed due to what the French Bureau d'Enquêtes et d'Analyses (BEA) determined to be a, "Deliberate and planned action of the copilot, who decided to commit suicide while alone in the cockpit" (FSF, 2016, para 1). An investigation uncovered that the first officer had been taking unapproved prescription medication for mental health issues, and the medication had caused adverse side effects (FSF, 2016). The investigation also uncovered that a general care physician had recommended additional psychiatric evaluations and hospitalization for the first officer (FSF, 2016). Reports also indicated he had been previously diagnosed with psychosis (FSF, 2016).

U.S. General Aviation Accident Statistics

In 2007, a research study was conducted that evaluated SSRI usage in pilots and accident rates in the U.S. Between 1990 and 2001 there were 61 fatal aviation accidents where SSRIs were found in the pilot's blood system (Sen, Akin, Canfield, & Chaturvedi, 2007). Of the 61 cases studied, 59 of the pilots had medical records in the FAA's Medical Certification Database, while two of the pilots did not have medical records on file (Sen et al., 2007). Previous incidents of driving while under the influence were reported by 22 of the 59 pilots (Sen et al., 2007). Seven of the 61 pilots disclosed psychological problems on previous medical applications that were subject for disqualification (Sen et al., 2007). Of those seven pilots, three reported using an SSRI (Sen et al., 2007).

At the time of the study, researchers noted that newer generation antidepressants were being developed that were more effective at treating anxiety and depression than older generation antidepressants (Sen et al., 2007). However, at the time of the study, the FAA did not approve SSRIs for use despite research findings (Sen et al., 2007). Out of the 61 cases studied, 12 pilots were found to have a medical history of SSRI usage with a previous diagnosis of psychological conditions or psychiatric disorders (Sen et al., 2007). In two of these cases, the conditions and disorders were reported to the Civil Aerospace Medical Institute (CAMI) (Sen et al., 2007).

Most of the pilots in this research study held a private pilot certificate with a third-class medical (Sen et al., 2007). Approximately 20% of the pilots in these cases were found to have been flying without a valid medical, and approximately 21% of the pilots were found to be medical professionals (Sen et al., 2007). A final analysis indicated that in 19 of the 61 cases, the pilot's SSRI use or psychological condition was the probable cause or contributing factor in the accident (Sen et al., 2007).

Treatment Options

Even though the FAA only approves four SSRI medications (FAA, 2017a), there are many other SSRIs on the market such as Paxil, norepinephrine-dopamine reuptake inhibitors (NDRIs) such as Wellbutrin, serotonin and norepinephrine reuptake inhibitors (SNRIs) such as Cymbalta, or next-generation medications such as Buspar that may work better for one pilot over another (L. Anderson, personal communication, July 16, 2018). While the FAA may slowly be aligning their views with ICAO and the international community, past and current views may cause a stagnation point and confusion for pilots regarding the appropriate course of action. Social stigmas may also alter a pilot's ability to make sound decisions regarding obtaining a medical diagnosis, exploring treatment options, and seeking other forms of help.

Social Stigmas

According to the Flight Safety Foundation's recommendation, pilots need an outlet to get the assistance they require without fear of reprisal from legislators, regulators, their employers, or the general public (FSF, 2016). In September of 2015, a study was conducted that examined public stigma before and after the Germanwings crash. Population surveys conducted in Germany between 1990 and 1991, and again after the Germanwings crash, indicated an increased stigma against people with a mental disorder than before the crash (Schomerus, Stolzenburg, & Angermeyer, 2015). In one study, respondents indicated they would have been more willing to sublet a room to someone with known schizophrenic tendencies than after the Germanwings crash (Schomerus et al., 2015). The results of the test indicated a change of respondent unwillingness by 24% (Schomerus et al., 2015).

While social stigma can be an issue, there are those that feel the public should be made aware when a flight crew member is taking any medications. A public comment posted on cbsnews.com stated:

> Passengers should be informed several days before a flight if either pilot or copilot are taking any medication that has even the remotest [SIC] possibility of presenting a danger to passengers so they can make an informed decision whether to take that flight or to change to a flight conducted by healthy non-medicated pilots. (Jackson, 2010, p. 66)

The public appears to demand that all airline pilots are mentally healthy and non-medicated individuals (Jackson, 2010). However, it is not reasonable nor practical when the public has the assumption that pilots are not human beings (Jackson, 2010). This outlook does not make the skies safer (Jackson, 2010).

Pilot Compliance

Public views of pilot mental health may become a deciding factor regarding how aviation authorities choose to certify their pilots. Studies conducted in the U.S. between 1993 and 2012 concluded that pilot suicide rates were approximately 0.33% (Persaud, & Bruggen, 2015). Similar studies in the UK between 1956 and 1995 had almost identical results indicating rates at 0.3% (Persaud, & Bruggen, 2015). In addition, a German study concluded that between 1974 and 2007 the suicide rate among pilots was only 0.29% (Persaud, & Bruggen, 2015). Yet, many pilots are afraid to come forward even though symptoms of anxiety and depression are typically short-term, with minimal chances of reoccurrence after treatment (Persaud, & Bruggen, 2015). The FAA stated that inquiries to the Aviation Medicine Advisory services indicated that approximately 59% of airmen do, or would, refuse to use SSRI medication if they were prescribed one (Persaud, & Bruggen, 2015). Approximately 15% of airmen indicated they would take SSRI medication without notifying the FAA (Persaud, & Bruggen, 2015).

Between 1997 and 2001, the Airline Pilots Association (ALPA) stated that more than 1,200 pilots contacted their offices indicating a recent diagnosis of depression (Presenter, Evans, 2013). Approximately 60% of those who contacted the ALPA indicated they would continue flying without taking necessary medications (Presenter, Evans, 2013). Approximately 15% advised they would take the recommended medications without adequately notifying the FAA (Presenter, Evans, 2013). Approximately 25% indicated they would take the recommended medications and cease flying (Presenter, Evans, 2013).

Purpose and Significance of the Study

The purpose of this research study was two-fold. First, the findings from the study will help conclude whether the FAA's viewpoints regarding mood disorders and treatment options are too stringent or outdated when compared to recommendations by ICAO and the medical certification standards of other ICAO States. Second, the responses from the participating U.S. pilot group should help identify how familiar they are with FAA views regarding mood disorders and SSRI use in airmen, as well as indicate whether current FAA medical certification standards for mood disorders and SSRI use are beneficial to the U.S. pilot population.

This international research study will be significant because anxiety and depression are common mood disorders among the pilot population (Stoutt, n.d.; Transport Canada, 2018). Only a few studies regarding U.S. pilots and the use of SSRI medications have been conducted compared to the more significant number of SSRI research studies completed within the

international community and their pilot populations. The findings from this study may assist in determining if current FAA certification standards are too stringent and how those standards affect pilots suffering from these disorders. The findings will provide additional information for both the FAA and the aviation community on the subject of pilots and SSRI medications that may not have been previously considered or publicly shared in the literature.

Research Questions

The following research questions were developed to align with the intent of this study:

RQ1 - Are the FAA's certification standards for pilots suffering from anxiety and/or depressive disorders too stringent, limited, or outdated when compared to ICAO or other ICAO States?
RQ2 - Are the FAA's certification standards for pilots taking SSRIs as a treatment option for anxiety and/or depressive disorders too stringent, limited, or outdated when compared to ICAO or other ICAO States?
RQ3 - Can medical physicians outside the FAA provide additional support regarding the adequacy or inadequacy of pilot certification standards for those suffering from anxiety, depression, or who are using SSRIs?
RQ4 - How does the U.S. pilot population view FAA certification standards on the subject of SSRIs, anxiety, and depressive disorders?

Limitations

Limitations of this study included:

1. The data gathered by the researchers was limited by the actual number of participants that volunteered to complete the research questionnaire and the personal interviews.
2. The amount of information the FAA, ICAO, and ICAO States were willing to share regarding the subject.
3. The FAA, ICAO, and ICAO State employees' professional knowledge on the subject matter.
4. The number of published research studies regarding pilot use of SSRI medications.
5. If participants answered the questionnaire or interview questions honestly and without any influence, actual or perceived.
6. Due to time constraints, some participants were unable to provide phone interviews but rather communicated in writing for convenience.
7. Due to time and availability, the number of non-aviation medical physicians able to participate in this study was limited.
8. A convenient sampling of participants was acquired via email and professional career forums.

Methodology

Selection of the Population

Three distinct population groups were invited to participate in this qualitative research study. Group I comprised of representatives from aviation governing agencies and their respective medical certification divisions. Group II comprised of U.S. certificated pilots. Group III comprised of a non-aviation medical physician.

Group I agencies invited to participate in this study included: (1) the Civil Aviation Authority of the UK (CAA); (2) the Civil Aviation Safety Authority (CASA) (Australia); (3) the Directorate General for Civil Aviation (DGAC) (France); (4) the Federal Aviation Administration (FAA) (United States); (5) the International Civil Aviation Organization (ICAO) (headquartered in Montreal); (6) the Luftfahrt-Bundesamt (LBA) (Germany); (7) the Swedish Transport Agency (STA); and (8) Transport Canada (TC).

Group I participants were selected by the researchers based on current research contributions related to the subject of anxiety, depression, and SSRI use in the pilot population. Transport Canada and CASA are pioneer ICAO States regarding research, acceptance, and certification procedures for airmen suffering from anxiety, depression, and/or taking an SSRI (ICAO, 2008). ICAO was asked to participate because the organization issues guidance on the subject for other ICAO States to consider when certifying their airmen. The FAA was selected for comparative purposes with ICAO and other ICAO States.

Group II was a convenient sampling of the U.S. pilot population. The researchers did not specify any participation requirements regarding levels or type of certificates held, nor experience. Participation was available to any U.S. certificated pilot age 18 or older.

Group III was a convenient sampling of a local general care facility. An email invitation was sent requesting participation from available non-aviation medical physicians at that facility who could provide a non-aviation medical interpretation of the FAA's responses to the survey questions. The purpose of the physician's opinion was to develop a comparison between two distinct medical standards: general medicine vs. aerospace medicine. Moreover, guidance from the non-aviation medical physician was sought to determine if any safety concerns are prevalent in those individuals prescribed an SSRI while operating an aircraft.

Data Collection & Analysis

Group I Data Collection. Participants in Group I received an email invitation from the researchers that outlined the scope and purpose of the study. The researchers developed a list of ten interview/survey questions and included these questions in email invitations. A request was made to each agency for an authorized medical expert with knowledge of administrative policies to participate in a brief telephone or Skype interview with the researchers. Due to time constraints, most of the aviation governing agencies willing to participate in this research study decided to provide written answers through email communication instead of verbal responses.

The interview questions focused on the agency's knowledge and opinion regarding the following topics:

1. The FAA's past and current certification process of airmen diagnosed with or suffering from, anxiety, depression, and/or taking an SSRI.
   Why did a given agency, if applicable, choose to change its opinion and the certification process for airmen diagnosed with, or suffering from, anxiety, depression, and/or taking an SSRI?
   What information does a given agency consider when making policy changes?
2. Are there other options available to airmen should a specific medication or treatment option not be a viable solution for a given individual?
3. Are there other factors for a given agency that may result in denial of a medical application even though that airmen met and complied with the application process?
4. Does a given agency have policies in place to ensure airmen compliance with new standards?
5. Does a given agency estimate how many airmen are, or are not, complying with the certification standards?
6. Evaluate a statement from the Australian Civil Aviation Safety Authority regarding individuals that take medication for anxiety and/or depressive disorders are no more dangerous than those who have not been diagnosed with, nor suffer from, one of these disorders.
7. Determine if the FAA's certification standards are more or less restrictive than ICAO's recommendations.
8. Any additional comments.

Group I Data Analysis. Data from Group I was evaluated based on interview or survey questionnaire responses and a given State's certification standards. Responses were evaluated and compared using descriptive statistical analysis. Comparisons were made between each agency that participated against similar questions from the other agencies. In addition, a comparison to current certification standards from ICAO and other ICAO States was used.

Group II Data Collection. Based on 2017 FAA statistics, there were 609,306 valid pilot certificates issued in the U.S. (FAA, 2017b). Using this reported population size of Group II, a confidence level of 95% that yields a Z-Score of 1.96, and an estimated margin of error with a value of 4, the researchers determined that a sample size of 600 participants would be required for this study. The Group II population was invited to participate through email communications, professional pilot forums, and personal contacts. Each certificated pilot represented in Group II was asked to complete a four-question survey, and participation was voluntary. To ensure the highest pilot response rate possible, closed-end survey questions were used which only required a yes or no response.

Group II participants were asked to respond to the following topics:

1. Whether the participant agreed to the adequacy of the FAA's policy regarding pilot medical certification standards for anxiety and depression before 2010;

2. Whether the participant agreed to the adequacy of the FAA's policy regarding pilot medical certification standards for anxiety and depression after 2010;
3. Whether the participant agreed to the adequacy of the FAA's policy regarding pilot medical certification standards for anxiety and depression in 2015; and
4. Whether participants agreed to and were aware of Australia's research, views, and pilot medical certification standards for anxiety and depression dating back to the 1980s.

Email invitations for Group II participation were sent to aviation students enrolled at four U.S. collegiate flight programs. The National Business Aviation Association's (NBAA) database was used by the researchers to identify corporate flight operators in each state. Lists for each state were randomized to maintain objectivity, and the first two flight departments generated from each state were sent email invitations inviting their employed certificated pilots to participate in the study. Lastly, invitations to participate in the study were posted on the following three professional pilot forums: (1) Airlinepilotcental.com; (2) Jetcareers.com; and (3) Propilotworld.com. Approximately 1,570 Group II invitations were issued to participate in the survey. The researchers received 148 surveys from Group II participants over 45 days; however, only 125 surveys were completed.

Group II Data Analysis. SurveyMonkey was used for data collection and analysis of the pilot survey question results. In addition, an Excel spreadsheet was used to evaluate responses rates and identify percentages of yes and no responses to each survey question. Group II responses were then evaluated using descriptive statistical analysis and to compare Group II responses against FAA certification standards.

Group III Data Collection. A list of local general care facilities was created, and the list was randomized. The first group on the list was selected to represent Group III. An email invitation was sent requesting participation from available non-aviation medical physicians at that facility. A physician agreed to evaluate the collected data from the FAA's survey responses. In addition, the physician agreed to provide a professional opinion regarding current and past ICAO recommendations, and FAA as well as ICAO State certification standards for those suffering from anxiety, depression, and/or taking an SSRI. In addition, the participating physician volunteered to forward the interview questions to other non-aviation medical practitioners to obtain additional comments. Due to time constraints, only one physician responded. Although only one physician participated, responses may be an indication of how other physicians could respond in future research with greater samplings.

The survey questions for the Group III participant focused on the following topics:

1. Professional opinion regarding FAA policies regarding anxiety, depression, and SSRIs;
2. Professional opinion regarding FAA decision to only allow four SSRI medications to be prescribed to airmen;

3. Professional opinion regarding the benefits of the four approved medications vs. other treatment options or medications;
4. Professional opinion regarding whether FAA policy regarding pilot medical certification standards for anxiety and depression was adequate before 2010;
5. Professional opinion regarding whether FAA policy regarding pilot medical certification standards for anxiety and depression was adequate in 2010;
6. Professional opinion regarding whether FAA policy regarding pilot medical certification standards for anxiety and depression was adequate in 2015; and
7. Professional opinion when comparing ICAO and ICAO State certification standards to the FAA.

Group III Data Analysis. Group III responses were evaluated using descriptive statistical analysis. Physician responses were used as a comparison to medical standards and practices outside of aviation. In addition, the participating physician was asked to evaluate the FAA's survey questionnaire responses and provide additional information to help compare the difference in medical practices.

Findings & Discussion

Group I: Analysis of Survey Data

The FAA. The Federal Aviation Administration (FAA) was asked to respond to questions regarding its certification process, evaluation standards set by ICAO, and certification standards used by other ICAO States. On behalf of the FAA, the Deputy Federal Air Surgeon provided the following responses to the ten survey questions (Table 1):

Table 1
FAA Responses to Survey Questions

FAA Survey Questions	FAA Responses (Deputy Federal Air Surgeon)
The FAA's past and current certification process of airmen diagnosed with or suffering from, anxiety, depression, and/or taking an SSRI.	*"The basis for the determination was scoping in on the history of 'mild depression' and determining that no other medical or psychiatric conditions were present. And that current medication treatment was adequate. The time frame specified has been adequate. This interval of time provided more flexibility in less severe depression cases."*
Why did a given agency, if applicable, choose to change its opinion and the certification process for airmen diagnosed with, or suffering from, anxiety, depression, and/or taking an SSRI?	*"The FAA medical officers and FAA psychiatrist determined, that based on case reports and personal clinical experience that the psychiatric condition and use of acceptable medications that had a low side-effect profile would not impact the safety of the National Airspace System."*
What information does a given agency consider when making policy changes?	*"The FAA Aerospace Medicine program is science-based that relies upon evidence-based medical literature and clinical experience to make its medical/management decisions. We also rely upon consultant reviews and the national database of aircraft accidents to validate our medical determinations."*
Are there other options available to airmen should a specific medication or treatment option not be a viable solution for a given individual?	*"The diagnosis and medications we determined could be used by aviators all are low risks conditions. And the medications approved have the lowest possible side-effect profile. We are not considering any other antidepressant medications at this time."*

Are there other factors for a given agency that may result in denial of a medical application even though that airmen met and complied with the application process?	*"The essence of a denial of an FAA airman medical certificate is based upon clinical review of the psychiatric history. If the individual under consideration does not meet the FAA published requirements or the approved psychiatric medication was discontinued that is not clinically explained and other psychiatric conditions or medical conditions are present, then the applicant will be denied."*
Does a given agency have policies in place to ensure airmen compliance with new standards?	*"There is an active program that is managed by FAA Aerospace Medicine SSRI program medical personnel. The underpinnings of the program include educating the FAA Aviation Medical Examiners who are the first representatives of the FAA that interact with aviators. The reporting requirement stipulated in the program are published and clear. The information is provided in real time and medical determinations are made in real time. The overall process is always under review using QMS/SMS processes."*
Does a given agency estimate how many airmen are, or are not, complying with the certification standards?	*"We have no way of determining who is not complying with the program. However, after 7 years we have 500 aviators who have participated in the program. We acknowledge that this is a fraction of the aviator population who most likely are flying with the condition and medications without our knowledge."*
Evaluate a statement from the Australian Civil Aviation Safety Authority regarding individuals that take medication for anxiety and/or depressive disorders are no more dangerous than those who have not been diagnosed with, nor suffer from, one of these disorders.	*"The FAA Aerospace Medicine managers do not agree with the Australian CAA. We would not be granting special issuance medical certificates if we did not believe that the risk was close to that of the unaffected population."*
Determine if the FAA's certification standards are more or less restrictive than ICAO's recommendations.	*"We have not evaluated their process."*
Any additional comments.	*"We have collaborated with the ICAO prior to adopting our current policy. This collaboration has led to ICAO adopting a recommended practice that is sufficiently flexible to allow case by case consideration of affected applicants."*

Analysis of FAA responses. The FAA representative stated that the agency's determination to change its standardization regarding anxiety, depression, and SSRI usage is not solely dependent on decisions made by other ICAO States, but rather in alignment with recommended standards and practices by ICAO. However, past research studies indicated that the FAA considered viewpoints of multiple agencies and organizations when evaluating whether to revise its standards (Diamond, 2018; FAA, 2010). While the FAA states they are unaware of how many airmen are complying with the current certification and reporting standards, past research indicates that approximately 59% of airmen are not complying with FAA standards and are hiding their medical information from the FAA (Persaud & Bruggen, 2015).

It is the FAA's opinion that the four currently approved medications are appropriate and offer the lowest chance of side effects for airmen. However, there are no provisions available for an airman who may not respond effectively to one of the four FAA-approved medications. In addition, the FAA does not agree with Australian findings in that those individuals who take medication for anxiety and/or depressive disorders are no more dangerous than those who have not been diagnosed with or suffer from a mood disorder. However, while the Civil Aviation

Safety Authority (CASA) has made this determination, they too require applicants to apply for a special issuance medical (Werfelman, 2008). CASA certification standards are less restrictive than those of the FAA. In addition, the FAA does not appear to be aware whether its certification standards are more stringent than ICAO recommendations or other ICAO States certification standards. Furthermore, the FAA can deny a pilot applicant who successfully met initial certification requirements if the FAA believes the applicant's past psychiatric history raises safety concerns.

The Civil Aviation Authority of the UK (CAA). The Civil Aviation Authority (CAA) of the UK was asked to respond to ten questions regarding its certification process, to evaluate standards set by ICAO, and evaluate certification standards used by other ICAO States. On behalf of the CAA, the Chief Medical Officer of the Safety and Airspace Regulation Group for the UK Civil Aviation Authority, provided the following responses (Table 2):

Table 2
CAA Responses to Survey Questions

CAA Survey Questions	CAA Responses (Chief Medical Officer of Safety and Airspace Regulation)
The FAA's past and current certification process of airmen diagnosed with or suffering from, anxiety, depression, and taking an SSRI.	*"The UK CAA accepts Citalopram, Sertraline, Escitalopram as maintenance therapy for those pilots wishing to maintain their medical certification. This is in conjunction with psychiatric assessments, simulator checks and Medical Flight Tests dependent on the class of medical certification. An OML (Operational Multi Pilot) Limitation on the certificate is imposed until 6 months cessation of all treatment. The UK CAA does not make judgements* [SIC] *on other Aviation Authority certificatory decisions or their rationale behind their policy decisions."*
Why did the CAA, if applicable, choose to change its opinion and the certification process for airmen diagnosed with, or suffering from, anxiety, depression, and/or taking an SSRI?	*"The UK CAA policy was amended 5 years ago when the EU Aircrew Regulation was implemented in the UK, permitting this policy."*
What information does the CAA consider when making policy changes?	*"Any change in UK CAA policy regarding medical certification is undertaken following review of new evidence and research that may indicate a change is appropriate, in conjunction with expert medical opinion in the field. Full consideration is given to rationale behind the policy being reviewed and aviation safety implications."*
Are there other options available to airmen should a specific medication or treatment option not be a viable solution for a given individual?	*"Current acceptable SSRI by the UK CAA are Citalopram, Sertraline and Escitalopram as maintenance therapy. No other psychotropic medication is permitted."*
Are there other factors for the CAA that may result in denial of a medical application even though that airmen met and complied with the application process?	*"The guidance for medical certification can be found on the CAA website. If an applicant does not meet the requirements for initial/renewal or revalidation then a medical certificate cannot be granted."*
Does the CAA have policies in place to ensure airmen compliance with new standards?	*"The CAA website provides the steps an applicant should follow to ensure compliance. The AMEs and CAA Psychiatrists are aware of this guidance and support the applicant in the steps to gain certification if appropriate."*
Does the CAA estimate how many airmen are, or are not, complying with the certification standards?	*"It is for the applicant to notify their AME if there is any change in their medical fit status or medication regime. Any changes that are identified at a medical and have not been declared by the*

	applicant are thoroughly investigated and action taken accordingly. Non-compliance estimates are not available."
The CAA was asked to evaluate a statement regarding individuals that take medication for anxiety and/or depressive disorders pose no significant safety risks.	*"The ICAO website states, '…In recent years, the use of SSRI (selective serotonin re-uptake inhibitors) has become widespread and there is indication that such treatment, aimed at preventing a new depressive episode, may be compatible with flying duties in carefully selected and monitored cases'. We agree with this statement."*
The CAA was asked to evaluate whether, in their opinion, if CAA's certification standards were more or less restrictive than ICAO's recommendations.	*"The UK CAA adheres to EU regulations and cannot comment on the standards in other ICAO states"*
Any additional comments.	No additional comments were provided by the CAA of the UK.

Analysis of CAA responses. The CAA responses to the survey questionnaire demonstrate similarities as well as distinct differences in certification standards from those of the FAA. For example, while the CAA does not consider policy issued by other ICAO States in their decision-making process, they do review all current research and ICAO recommendations before implementing new policies; a policy the FAA stated they employ as well. The CAA is similar to the FAA in that they only allow certain approved medications to be used by certificated pilots. The CAA is not opposed to making changes in policy pending the information is supported by proven research. Therefore, while a provision does not exist for an applicant to use a non-approved medication, future research results may influence the CAA to change their current standards.

One specific area the CAA differs from the FAA is regarding how the CAA views ICAO's statement that individuals who are treated for anxiety or depression, when properly medicated and monitored, pose no significant safety risks within the flight environment. The CAA agrees with ICAO's statement which is also similar to the statement made by CASA. The FAA was asked to evaluate CASA's statement and not ICAO's. However, the FAA does not agree with these statements.

ICAO. The International Civil Aviation Organization was contacted by the researchers and asked to respond to five questions regarding the certification process for airmen suffering from, or diagnosed with, anxiety, depression, and/or taking an SSRI. The Chief of Aviation Medicine for ICAO explained the rulemaking process and ICAO opinions in the following response (Table 3):

Table 3
ICAO Responses to Interview Questions

ICAO Survey Questions	ICAO Responses (Chief of Aviation Medicine)
Does ICAO has an opinion regarding member State certification processes?	*"ICAO roles and responsibilities for a given topic may be both regulatory in nature as well as advisory. In addition, ICAO standards are compulsory, and ICAO States are required to comply with these standards. However, States have the authority to determine whether they will implement ICAO recommended*

	practices, and each State may set their own guidelines There is no baseline for measuring mental health as there are with checking one's blood pressure or cholesterol levels. Not every individual pilot will have similar positive results regarding treatment options."
How and when did ICAO decide to change the policy on the topic of mental health and pilots? In addition, what considerations does ICAO make before implementing new policies and guidance?	*"Before ICAO considers a topic such as mental health in aviation, ICAO may elect to evaluate a given subject on their own or take subjects under further consideration based on State recommendations. Once ICAO has evaluated research from other States, ICAO may elect to notify States of its intent to issue proposed rulemaking and guidance. However, any proposal requires a vote from all ICAO representative States."*
Does ICAO offer guidance to States regarding what medications should be considered and approved?	*"ICAO is willing to defer much of the certification process and standards to the States when making a final determination regarding the airmen certification process. Some States have implemented additional requirements which are not ICAO recommendations. For example, some States require airmen to receive regular psychiatric evaluations and follow-up exams even with the successful demonstration of a prescribed medication. In addition, some States require either simulator or flight check to verify safety standards."*
Does ICAO offer guidance to States for or require states to demonstrate pilot compliance with regulations?	*"ICAO does not offer guidance on which medications should be approved or recommended. Instead, ICAO defers to each State to conduct its own research and make the decision as to which medication it may be willing to approve for airmen use. ICAO advises each State that one must understand the underlying reason a given medication was prescribed to an airman. Each State's primary concern should be aviation safety and whether a prescribed medication can interfere with or reduce safety margins within the flight environment."*
Does ICAO maintain statistics pertaining to compliance for a given ICAO State?	*"Initially, ICAO did not enforce, or require States to demonstrate or provide percentages of compliance or treatment success rates of airmen. However, in 2016, ICAO asked States to begin tracking statistical data to identify how many accident and incidents occurred as a direct result of an airman's mental health and SSRI use. ICAO intends to use this data to conduct further research on the subject and unify certification standards at some point in the future."*

Analysis of IACO responses. Lastly, the ICAO representative stated BasicMed has presented new challenges in the certification process. Europe, for example, now offers BasicMed which is similar to the certification program in the U.S. These programs have significant deficiencies in tracking and identifying pilots who have, or had, serious medical conditions. Currently, there is no adequate way to track these pilots, and additional ICAO States are expected to adopt similar BasicMed programs (A. Jordaan, personal communication, July 12, 2018).

Transport Canada. Transport Canada (TC) was asked to respond to questions regarding its certification process, evaluation standards set by ICAO, and certification standards used by other ICAO States. On behalf of Transport Canada, the Senior Consultant of Civil Aviation Medicine provided the following responses to the ten survey questions (Table 4):

Table 4

Transport Canada Responses to Survey Questions

Transport Canada Survey Questions	Transport Canada Responses (Senior Consultant - Civil Aviation Medicine)
The FAA's past and current certification process of airmen diagnosed with or suffering from, anxiety, depression, and/or taking an SSRI.	*"Yes. Our guidelines state "initial applicants who are still on medications must be at a stable dose for at least 4 months without aeromedically significant symptoms/side effects before submitting a detailed report from their attending physician".*
Why did Transport Canada, if applicable, choose to change its opinion and the certification process for airmen diagnosed with, or suffering from, anxiety, depression, and/or taking an SSRI?	*"Although TC guidelines were published online around 2010 we had considered and certificated some professional pilots (while taking an SSRI) for restricted flight (with an accompanying pilot) since at least 2004. One argument was that by then many pilots were already taking maintenance doses (sometimes for years after successful treatment of an acute depression) but not declaring this use since they would be grounded until the current policy was adopted."*
What information does Transport Canada consider when making policy changes?	*"When TC changes a policy (such as treatment for anxiety and depression) prior to making a decision we consider our experience and convene workshops involving all of our aviation medical officers (who are aerospace medicine specialists) as well as relevant clinical practitioners. In addition, we review ICAO and international aviation medicine practice and guidance."*
Are there other options available to airmen should a specific medication or treatment option not be a viable solution for a given individual?	*"When our guideline was published we were considering only Prozac (fluoxetine), Zoloft (sertraline), Wellbutrin (bupropion), Celexa (citalopram), and Ciprolex (escitalopram). Note that we never direct treatment but assess applicants 'as they are'. We have since considered and approved some applicants using other medications (such as venlafaxine and duloxetine)."*
Are there other factors for Transport Canada that may result in denial of a medical application even though that airmen met and complied with the application process?	*"TC will assess and reassess as necessary when the clinical state changes (or when our policy evolves). If a pilot or ATC develops aeromedically significant symptoms (e.g. depression) or side effects of medication (e.g. drowsiness) then they are prohibited from exercising the privileges of any license until we have re-assessed their case."*
Does Transport Canada have policies in place to ensure airmen compliance with new standards?	*"To ensure that all certificated pilots comply with the required regulations regarding anxiety, depression, and SSRIs, TC carefully monitors the physician reports, simulator ride or operational assessment reports and SSRI questionnaires that must be submitted in addition to the aviation Medical Examination Reports (MER) that are required annually in these cases."*
Does Transport Canada estimate how many airmen are, or are not, complying with the certification standards?	*"Of the (approximately 100 current) pilots and ATC recently assessed in the SSRI program, a small number have been administratively suspended under when they have been delinquent in submitting required reports. Most of these have been reinstated once the requested documents have been provided. Fewer have been re-assessed as unfit because their condition has deteriorated. It is more difficult to estimate the number of aircrew who have failed to disclose relevant clinical information (including all medications taken) during their MERs. Sometimes these pilots/ATC may be reported by their own physicians as required when a medical condition is likely to constitute a hazard to aviation safety under the Aeronautics Act 6.5."*
Transport Canada was asked to evaluate a statement from ICAO regarding individuals that take medication for	*"TC would agree that some pilots taking medication for anxiety and/or depressive disorders pose no significant safety risks, depending on the medication/side-effects, psychiatric history (e.g.*

anxiety and/or depressive disorders pose no significant safety risks.	*depression must be in stable remission after adequate treatment) and with careful (aviation) medical assessment."*
Transport Canada was asked to evaluate whether, in their opinion, if Transport Canada's certification standards were more or less restrictive than ICAO's recommendations.	*"Since most ICAO states still ground most if not all aircrew using SSRIs for any reason TC is less restrictive in practice. TC does this by assessing each applicant individually and applying appropriate flexibility in accordance with ICAO standard (Personnel Licensing) and our own 'flexibility' regulation."*
Any additional comments.	*"Canada was one of the first countries to permit antidepressant usage by professional pilots, and our experience supports continued use. Civil Aviation Medicine (CAM) will consider individual circumstances and apply flexibility to allow certain applicants using SSRI anti-depressants to exercise the privileges of licensure (such as flying with an accompanying pilot)."*

Analysis of Transport Canada responses. The responses from the consultant indicate that Transport Canada has a different approach than other ICAO States regarding pilots and mental health. While Transport Canada reviews recommendations by ICAO, they also consider medical research and practices from the international community as well. This differs from the FAA's response in that the FAA only considers ICAO guidance and not policy or opinion from other ICAO states.

While exact numbers are not available, Transport Canada acknowledges that some of their airmen have successfully been taking medications and receiving treatment options without notifying Transport Canada due to fear of being grounded by the agency. In addition, some have received violations for not adhering to regulatory compliance requirements. However, the agency hopes that these pilots will eventually come forward with the adoption of new policies and certification standards. Transport Canada initially only approved Prozac, Zoloft, Wellbutrin, Celexa, and Cipralex for airmen use. The consultant also cautioned that the agency never directs treatment. Instead, they evaluate conditions and recommendations made by the appropriate medical physician. In some cases, medication outside of those currently approved by Transport Canada has been allowed within specific guidelines.

Transport Canada believes their certification standards and policies are often less stringent than those of other ICAO States. Several ICAO States still ground applicants for mood disorders and SSRI use even though those applicants may meet certification requirements. This is regardless of whether that applicant demonstrated a successful trial period of an approved medication. While Transport Canada does not entirely agree with ICAO's statement of low-risk SSRI users, they do agree that some pilots pose a lower safety risk.

Swedish Transport Agency (STA). The Swedish Transport Agency (STA) was asked to respond to questions regarding its certification process, evaluation standards set by ICAO, and certification standards used by other ICAO States. On behalf of the Swedish Transport Agency, the Medical Assessor & Deputy Head for Aviation Personnel provided the following responses to the ten survey questions (Table 5):

Table 5
The Swedish Transport Agency (STA) Responses to Survey Questions

STA Survey Questions	STA Responses

	(Medical Assessor & Deputy Head for Aviation Personnel)
The FAA's past and current certification process of airmen diagnosed with or suffering from, anxiety, depression, and/or taking an SSRI.	*"I do not share your opinion that FAA is more stringent making aeromedical assessments. In Europe we work closely together with EASA and interact with ongoing rulemaking activities in this field (after the Germanwings catastrophe). Professional pilots in Sweden suffering from depression are all thoroughly evaluated on an individual basis, usually also reviewed by our own (authority) expert in psychiatry. We require a cognitive assessment before return to duty can be considered. In some cases approval with medication can be granted after simulator check and with limitation OML."* *"You should look at both the consolidated implementing rules (Part-MED) and the AMC + GM. Psychiatry is MED.B.055 but will soon be renamed mental health. With this link you can find the EASA rules we work within Europe. We also use national guidelines (together with Norway) and frequently follow the UK CAA flow charts. We are quite restrictive with moderate depressions, especially if there is a history of repeated illness, and require complete resolution of symptoms (usually an observation time of 3-6 months for professional pilots) before considering a new assessment."*
Why did the STA, if applicable, choose to change its opinion and the certification process for airmen diagnosed with, or suffering from, anxiety, depression, and/or taking an SSRI?	
What information does the STA consider when making policy changes?	
Are there other options available to airmen should a specific medication or treatment option not be a viable solution for a given individual?	
Are there other factors for the STA that may result in denial of a medical application even though that airmen met and complied with the application process?	
Does the STA compliance with new standards?	
Does the STA estimate how many airmen are, or are not, complying with the certification standards?	
The STA was asked to evaluate a statement from ICAO regarding individuals that take medication for anxiety and/or depressive disorders pose no significant safety risks.	
The STA was asked to evaluate whether, in their opinion, if Transport Canada's certification standards were more or less restrictive than ICAO's recommendations.	
Any additional comments.	

Analysis of STA responses. It was the opinion of STA Medical Assessor & Deputy Head for Aviation Personnel that the FAA's certification standards were not more stringent than those of the ICAO or other ICAO States. The STA sets their certification protocol based on European (EASA) standards and follows medical guidance issued by the Civil Aviation Authority of the UK. STA applicants are evaluated on a case-by-case basis and are often re-evaluated by an STA psychology expert. Should an applicant have moderate levels of depression, or a history of repeated illness; the STA is more restrictive in certifying that applicant. While the STA follows guidance issued by the CAA, their practices appear to be more restrictive than those of the FAA and other ICAO States who participated in this research study.

Group I: Common Themes Identified Across Agency Responses

Four out of eight agencies responded to the invitation to participate in this research study; however, the Swedish Transport Agency (STA) representative only offered a brief opinion rather than provide answers to each specific survey question. Of the three participating agencies, 66% stated they do not compare standards of other countries when making decisions to change policy. Only Transport Canada stated they consider both ICAO and other ICAO State opinions before making decisions. While the FAA indicated they do not consider other ICAO State information, research indicates that the FAA has considered Australia and other ICAO State opinions before making policy changes (FAA, 2010).

In addition, 66% of the participating agencies stated that no alternative options exist for an applicant should a particular SSRI treatment option not be effective. However, Transport Canada stated that while they use certain SSRIs that are approved for airmen, they would consider allowing an applicant to use another method of treatment with sufficient evidence supporting its safety and effectiveness. The FAA was not asked to evaluate ICAO's statement that airmen who take an SSRI will have no significant safety risk. However, they were asked to evaluate a Civil Aviation Safety Authority (CASA) opinion that individuals taking SSRIs are no more dangerous than those who have not been diagnosed or treated with a disorder. The FAA did not agree with this statement.

Agency participants were asked to evaluate ICAO's statement regarding SSRI medicated pilots and significant safety risks. Approximately 33% agreed that airmen prescribed an SSRI may no longer be considered a safety risk, while approximately 33% agreed with the statement only some of the time. Of the three participating agencies, 66% stated that they have policies in place that encourage airmen to comply with current certification standards. However, 66% of participants also stated that they have no effective means to ensure airmen compliance, and none of the agencies stated they have estimates of how many airmen are not complying with the standards.

ICAO defers final authority of airmen medical certification to the individual ICAO States, and ICAO provisions allow for each State to develop and implement more stringent standards. ICAO issues recommended standards and practices for each State to use as guidance when developing standards; however, ICAO does not offer guidance regarding medication for mood disorders. This includes the length of any potential demonstration period. Beginning in 2018 or 2019, ICAO will require States to share their statistical data with ICAO regarding airmen compliance and accident rates. The primary reason for sharing data with ICAO is to unify the certification process requirements for all ICAO States, and determine what regulatory changes are necessary for global harmonization of policies.

Group II: Analysis of Survey Data

Group II participants were asked to respond to four survey questions (yes or no answer).

Pilot survey: Question 1. Prior to 2010, FAA regulation stated that pilots diagnosed with anxiety and/or depressive disorders were prohibited from exercising the privileges of pilot

in command and obtaining a medical certificate. This also applied to those who may be taking medication as a treatment option for this disorder. In your opinion was this regulation adequate?

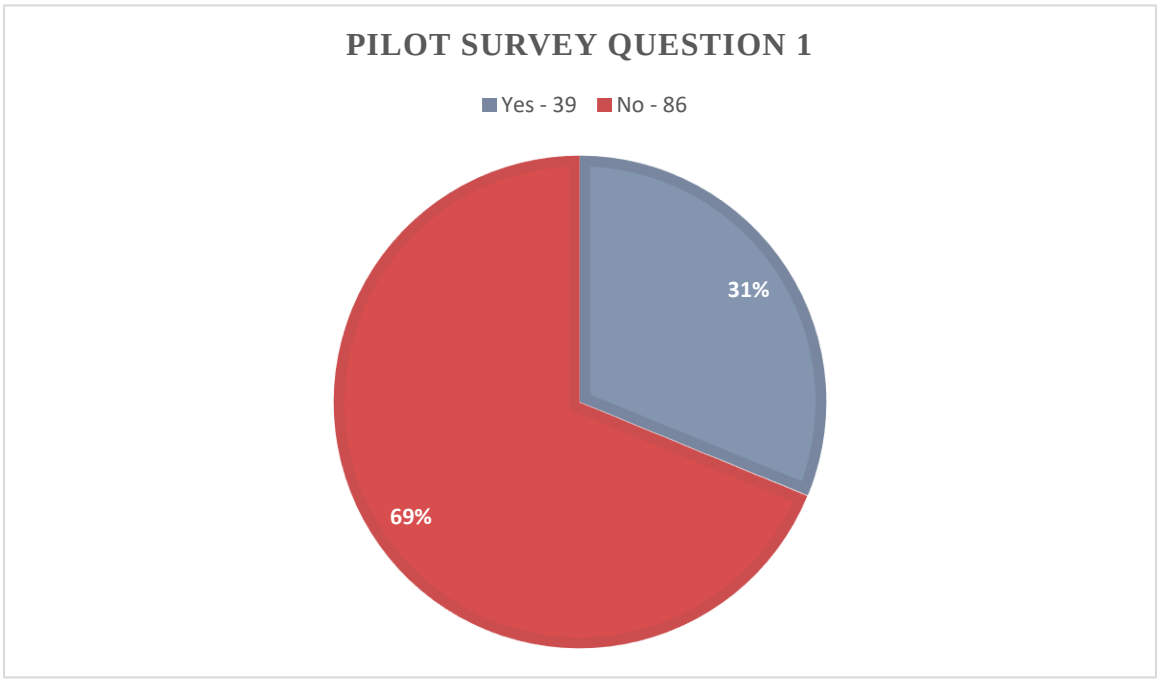


Figure 1. Pilot survey: Question 1 response results.

Analysis of pilot survey results: Question 1. Of the 148 respondents that participated in the survey, 125 completed survey question number one. Respondents were asked in their opinion if the FAA policy which prohibited individuals from flying and obtaining a medical certificate was adequate. Approximately 69% (86 participants) responded no that in their opinion the FAA's policies were not adequate, and those individuals did not agree with FAA views. Approximately 31% (39 participants) indicated that in their opinion FAA policy before 2010 was more than adequate. The results from survey question one may be an indicator that most of the U.S. pilot group, in total, would also agree with this statement, and find that the FAA policies were not adequate by prohibiting pilots from flying or obtaining a medical certificate due to suffering from a mood disorder.

Pilot survey: Question 2. In 2010, the FAA changed their certification standards regarding anxiety, depression, and treatment options. An applicant may be able to act as pilot in command and receive a medical waiver if one were to use an approved FAA medication. Certification required an applicant to show demonstrated use of the medication under the supervision of a psychiatric care physician for a period of twelve months. After twelve months an applicant may request a re-evaluation of their medical application by the FAA. An application could be approved or denied. In your opinion, was this an adequate certification process?

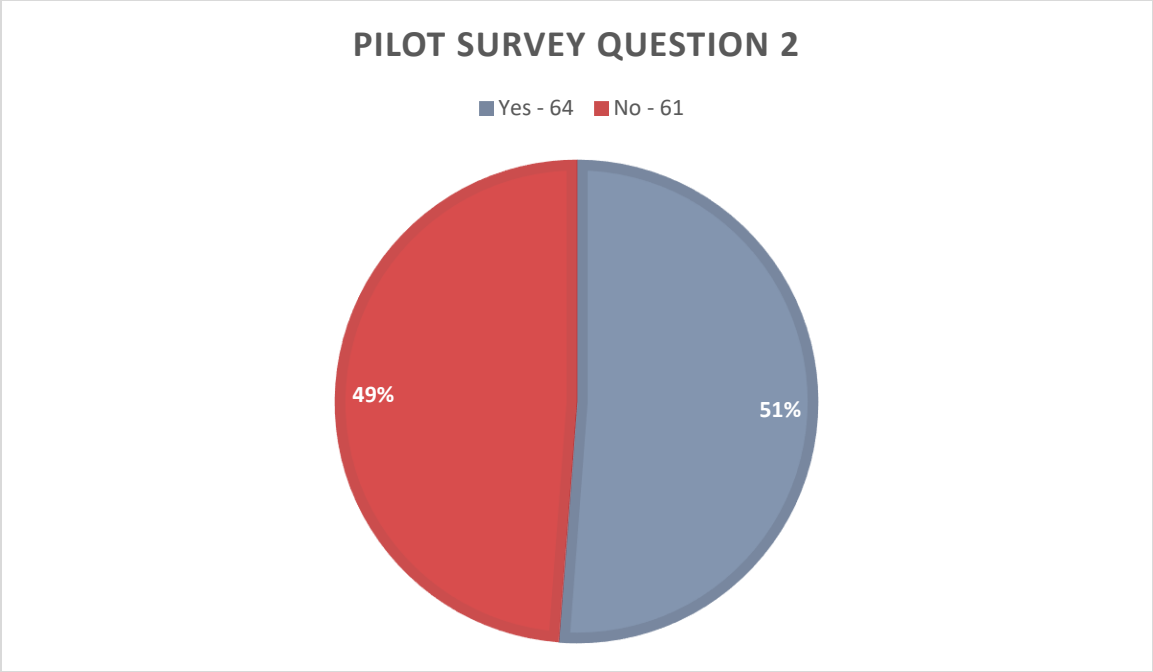


Figure 2. Pilot survey: Question 2 response results.

Analysis of pilot survey results: Question 2. Of the 148 respondents that attempted the survey, 125 completed question two. Respondents were asked that if in their opinion the FAA's policy, which prohibited individuals from flying and obtaining a medical certificate, was adequate after 2010. In many cases, an applicant was granted a medical certificate and could continue flying if certain conditions were met. Approximately 49% (61 participants) responded no that in their opinion FAA policies were not adequate, and those individuals did not agree with FAA views. Approximately 51% (64 participants) indicated that, in their opinion, FAA policy after 2010 was more than adequate. The results from survey question two may be an indicator that the U.S. pilot group, in total, could also be divided when evaluating this statement.

Pilot Survey: Question 3. In 2015, the FAA changed their certification standards regarding anxiety, depression, and treatment options. An applicant might be able to act as pilot in command and receive a medical waiver if one were to use an approved FAA medication. Certification required an applicant to show demonstrated use of the medication under the supervision of a psychiatric care physician. The demonstrated time frame was reduced from twelve to six months. After six months an applicant may request a re-evaluation of their medical application by the FAA. An application could be approved or denied. In your opinion, is this an adequate certification process?

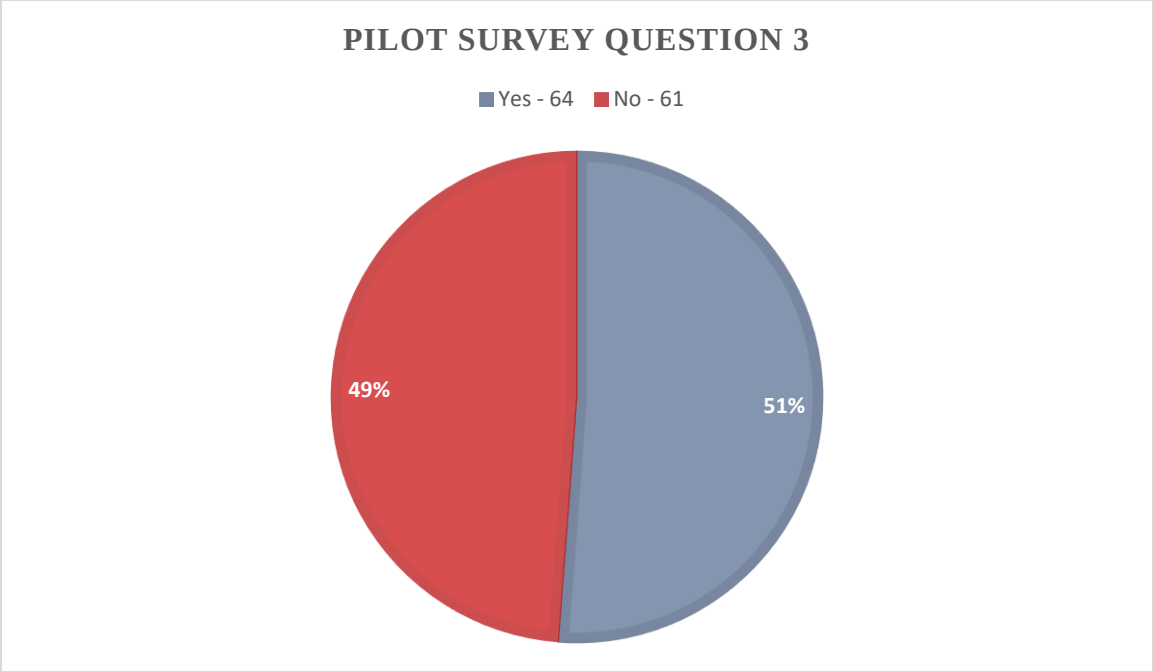


Figure 3. Pilot survey: Question 3 response results.

Analysis of pilot survey results: Question 3. Of the 148 respondents that attempted the survey, 125 completed question three. Respondents were asked, in their opinion, if the FAA policy which prohibited individuals from flying and obtaining a medical certificate was adequate after 2015. In many cases, an applicant was granted a medical certificate and could continue flying if certain conditions were met. Approximately 49% (61 participants) responded that in their opinion FAA policy was not adequate and indicated that those individuals did not agree with FAA views. Approximately 51% (64 participants) indicated that in their opinion FAA policy after 2015 was more than adequate. The results from survey question three may be an indicator that the U.S. pilot group, in total, could also be divided when evaluating this statement.

Pilot Survey: Question 4. As early as the 1980s, some ICAO States have allowed their pilots to use various medications to treat anxiety and/or depressive disorders. Australia, for example, is one of these States. Australia has a certification process that takes no more than thirty days. Moreover, the Australian Aviation Authority has concluded that individuals taking medication for anxiety and/or depressive disorders are no more dangerous than those who have not been diagnosed with, nor suffer from, anxiety and/or depression. Other ICAO States share a similar opinion with Australia regarding the certification process. Based on this information, when comparing it to how the FAA certifies U.S. pilots, do you find these certification standards are more reasonable than the FAA standards?

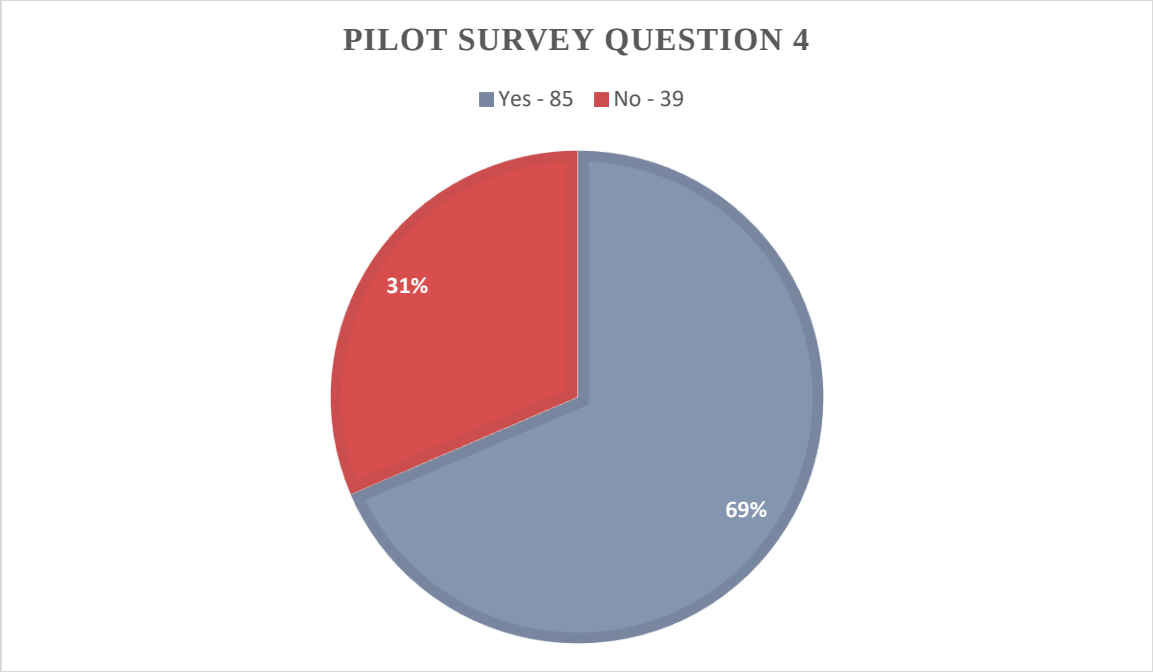


Figure 4. Pilot survey: Question 4 response results.

Analysis of pilot survey results: Question 4. Of the 148 respondents that attempted the survey, 124 completed question four. Respondents were asked to evaluate a statement made by the Civil Aviation Safety Authority (CASA) of Australia regarding the safety of airmen suffering from anxiety, depression, or taking medication. CASA research studies have indicated that those individuals being treated for a disorder are no more dangerous than individuals who do not suffer from or have been diagnosed with any disorders. ICAO and other ICAO States agree with the statement. In addition, participants were asked to compare this statement to the previous three questions regarding the FAA views on the subject before and after 2010. Participants were asked that, after reading this statement, if they found the FAA's current policy to be less reasonable than those of the international community. Approximately 69% (85 participants) agreed after reading the statement that in their opinion FAA policy was less reasonable and most likely not in line with international views on the subject. Approximately 31% (39 participants) indicated that current FAA policy was not more restrictive and more likely comparable to the international consensus on the subject. The results from survey question four may be an indicator that the U.S. pilot group, in total, could also agree with this statement

Group II participant mean responses. Survey results from Question 1 and Question 4 indicated that the majority of the sample group agreed that FAA policy and views before 2010 were inadequate when certifying airmen suffering from a mood disorder. In addition, when reviewing Australian and ICAO statements regarding the safety of airmen diagnosed with and/or seeking treatment options for anxiety and/or depression, a majority of the sample group found FAA views to be less reasonable when compared to the international community. In both cases, approximately 69% of the sample population found the FAA policies and views to be inadequate. Respondents were asked to evaluate FAA policy changes before and after 2010. In both instances, results were almost evenly split with approximately 51% of the group agreeing that FAA policy and views during this time were adequate, while approximately 49% disagreed.

Group III: Analysis of Survey Data

Non-aviation medical physician. Group III was comprised of one non-aviation medical physician who was asked to participate evaluate the FAA's responses to questions asked in this research study. After reviewing FAA responses, the participating medical physician (family practice) was asked to answer eight questions and provide a medical opinion regarding the FAA's certification process of airmen who suffer from, or have been diagnosed with, anxiety, depression, and/or taking an SSRI. The participant was asked to compare non-aviation medical standards and compare those standards to FAA responses when diagnosing patients. The survey questions and the physician's responses are represented in Table 6.

Table 6
Non-Aviation Medical Physician Responses to Survey Questions

Non-Aviation Medical Survey Questions	Responses (Non-Aviation Medical Physician)
Do you agree with the FAA responses?	*"I agree that the shortened 6 month time frame is plenty of time to assess whether a medication has improved anxiety and depressive symptoms."*
Can you provide an answer to why the FAA only allows four specific SSRIs for airmen?	*"I believe there is some basis to approving the four SSRIs approved. The four they have approved have a lower risk of sleepiness and fatigue. However, I believe this list could be expanded to add others to the approved list. There are some newer medications as well that should be safe."*
Are there benefits to only prescribing the four types of FAA-approved SSRIs?	*"The four SSRIs approved are all very safe and widely used. I agree that these medications have a low side effect profile and generally work very well. I think the list could be expanded" to add other SSRIs as well as SNRIs and Wellbutrin."*
Would the type of vehicle, equipment, or machinery influence the decision to prescribe a particular SSRI?	*"My decision to prescribe anxiety or depression medications would not be affected by someone operating heavy equipment, a motor vehicle, or anything larger than a passenger vehicle. However, I do warn people of the side effects of medication inducting sedation."*
Before 2010, was the FAA correct in prohibiting airmen from flying with a mood disorder and/or taking medication?	*"Prior to 2010, pilots were unlikely to seek medication for anxiety or depression, because they might lose their license to fly. They often asked me about herbal supplements instead, such as Sr. John's Wart (which has a potentially worse safety profile than SSRIs). I understand the need to regulate medications that might cause adverse effects to pilots, but I feel that pilots with uncontrolled depression or anxiety are a much riskier proposition. Also, because anxiety and depression are often felt short-term (6 months or less) and are often situational due to life stressors such as death, illness, or divorce, the FAA regulation prior to 2010 seemed unrealistic and unfair. Medication would often get symptoms under control in 4-6 weeks instead of waiting 6 months or so for symptoms to resolve on their own."*
After 2010, was the FAA correct in requiring a 12-month demonstration period before certifying an airman suffering from a mood disorder and/or taking medication?	*"I believe the certification process to approve a pilot to act as Pilot in Command is more than adequate with a 12-month psychiatry follow up. I would not recommend the need for more than 12 months or care."*

After 2015, was the FAA correct in reducing demonstration periods from twelve to six months prior to certifying an airman suffering from a mood disorder and/or taking medication?	*"I agree with the decision to reduce the time from 12 to 6 months for continued care. 6 months is more than adequate time to determine whether a medication is effective and to determine if adverse side effects are present."*
Participants were asked to evaluate the 30-day demonstration period Australia requires for its pilots regarding certification after diagnosis and treatment for a mood disorder. Participants were also asked to evaluate Australia's statements that pilots being treated for a mood disorder were no more dangerous than those who did not suffer from, nor have been diagnosed with anxiety and/or depression. In addition, participants were asked to evaluate whether, in their opinion, if the FAA's certification standards were more or less restrictive than ICAO's recommendations.	*"I think the FAA's more stringent guidelines for pilots should be relaxed somewhat. I think more medications should be considered safe to be used by pilots. The time frame could also be shortened to 3-6 months of treatment for mild depressive symptoms. I think that 30 days may be an inadequate amount of time to determine if therapy is working, so I think that more time should be given to determine efficacy."*

Analysis of physician responses. In evaluating the physician's responses, it seems they moderately agree with current practices in the aviation community. For example, the physician agreed that not all medications work for all patients, and a single medication cannot be considered a viable treatment option with every diagnosis. In addition, the physician agreed that the FAA reduction in demonstration time, implemented after 2010, was more appropriate for airmen. While the physician agreed that follow-up care is necessary, they did indicate that care beyond 12 months was not necessary. The physician's statement supported prior research, which indicated many mood disorders are often short-term, and the need for long-term treatment options are often unnecessary (Persaud & Bruggen, 2015).

Lastly, the physician did not agree with Australia's shortened demonstration period of four weeks. In their opinion, a three to four-month period is more than adequate to make proper dosage adjustments, change medications, and evaluate the potential for unwanted side effects. Nevertheless, prior research indicated that aviation medicine is specialized, and often non-aviation medical physicians are not aware of additional safety risks, or how a given medication may affect an individual when flying an aircraft (Ross, Griffiths, Dear, Emonson, & Lambeth, 2007; Stoutt, n.d.).

Conclusion

Differences in Research and Certification Standards

An important issue discovered during this research study identified the lack of unification between ICAO States and certification standards. In an interview with the Chief of Aviation Medicine for ICAO, the representative indicated that each ICAO State has the flexibility to create its own certification standards based on their research and local laws. States are encouraged, but not required, to review other State research and certification standards before developing their own. States are also encouraged to review ICAO recommendations and guidance in addition to reviewing industry research and recommendations. Because of differences across the international community, some State's may elect to use programs like BasicMed which stray away from normal medical certification standards for a given state. Furthermore, State demonstration periods, preferred or allowed medications, or the use of flight

or simulator evaluations may vary significantly from one region to another (A. Jordaan, personal communication, July 12, 2018).

A concerning discovery during this research study was the discontinuity in FAA views. In 2010, the FAA issued a press release which stated they considered views from industry leaders such as ICAO, the Aerospace Medical Association (AsMA), the Airline Owners & Pilots Association (AOPA), and other ICAO States prior making policy changes (FAA, 2010). The FAA issued guidance for special issuance of medical certificates for airmen and SSRI use during the same month as the press release. In the guidance, the FAA stated they reviewed procedures and views of the U.S. Army, Transport Canada, ICAO, Australia (CASA), the ALPA, and others in making their decision to change policy (FAA, 2010). Recently, the AOPA published an article also citing that the FAA considers research and recommendations form AsMA, Transport Canada, Australia (CASA), ICAO, the AOPA, the ALPA, and the U.S. Army (Diamond, 2018). However, despite these publications, the FAA indicated in this research study they do not consider other recommendations before making policy decisions.

Interpretation of Research Questions

RQ1 - Are the FAA's certification standards for pilots suffering from anxiety and/or depressive disorders too stringent, limited, or outdated when compared to ICAO or other ICAO States?

RQ2 - Are the FAA's certification standards for pilots taking SSRIs as a treatment option for anxiety and/or depressive disorders too stringent, limited, or outdated when compared to ICAO or other ICAO States?

RQ3 - Can medical physicians outside the FAA provide additional support regarding the adequacy or inadequacy of pilot certification standards for those suffering from anxiety, depression, or who are using SSRIs?

RQ4 - How does the U.S. pilot population view FAA certification standards on the subject of SSRIs, anxiety, and depressive disorders?

Research questions 1 & 2. Regarding RQ1, the researchers conclude that based on comparisons with ICAO and other ICAO States, the FAA was not more restrictive in its certification standards before 2010. In addition, the researchers conclude that the FAA is not more restrictive in its current certification standards when compared to ICAO and other ICAO States. Regarding RQ2, the researchers conclude based on comparisons with ICAO and most ICAO States that the FAA has similar viewpoints to those who participated in this research study. However, when comparing these standards with one of the participating ICAO State, Transport Canada, the researchers conclude that the FAA is limited in not allowing, or considering, alternative treatment options for those who may not benefit from one of the approved FAA medications.

Research question 3. The data results from research question three (RQ3) indicated that non-aviation medical physicians may not entirely agree with earlier FAA guidelines for airmen medical certification standards; however, non-aviation physicians may favor the FAA's recent policy revision that reduced the certification period to six months. The physician participating in this study did not indicate in their responses if the six-month certification time was excessive.

However, they did state that the new and revised timeframe was more reasonable. The physician also indicated that three to four months was an appropriate timeframe to identify any potential problems regarding the treatment of airmen. This timeframe is similar to the UK and Canadian certification standards (Presenter, Hutchinson, 2013; Transport Canada, 2018).

The researchers concluded that non-aviation medical physicians may not have agreed with earlier FAA medical certification standards. However, non-aviation medical doctors may agree with the certification standards revised after 2010. Yet, non-aviation medical physicians may not agree with the FAA's limited views regarding the approval of only four SSRI medications. While these medications are known for their effectiveness and low risk of side effects, they may not be effective for every pilot diagnosed with a mood disorder. Therefore, the FAA should be more willing to consider additional medications or alternative treatment options.

Research question 4. The responses to RQ4 indicated that most of the participating pilots agreed that FAA medical certification standards were too stringent; especially after evaluating Australian and ICAO statements regarding airmen, mood disorders, and SSRI use. While the results of the pilot survey regarding FAA views during and after 2010 varied, it is unknown to the researchers how many participating pilots: (1) were taking an SSRI; (2) have been denied a medical certificate; (3) have successfully obtained a medical waiver; (4) were taking non-approved medications; and/or (5) suffered from a mood disorder but elected not to seek treatment options. This research study did not evaluate these variables to determine whether one or more of them may have been a factor in a pilot's responses. However, based on the data collected for this study, the researchers conclude that the majority of the participants agree that FAA certification standards were too stringent before 2010. Most participants believed FAA certification standards revised in 2010, and after, were sufficient and reasonable.

Recommendations

Recommendation 1. Based on the findings of this study, the researchers recommend the FAA implement an improved tracking procedure regarding compliance, accident rates, and the effectiveness of treatment among airmen. This recommendation will be more in-line with ICAO recommendations and requirements to track medical information better.

Recommendation 2. Prior research has indicated that in order to make more informed decisions, multiple disciplines need to work collaboratively to develop conclusions and recommendations when addressing aviation safety and psychological medications (Nicholson, 2003). Aerospace and conventional medical practices are significantly different. Those who practice aerospace medicine focus on the general safety and health of those operating in the flight environment, whereas general and psychiatric care practitioners may not understand the effects of medication and human physiology in flight (A. Jordaan, personal communication, July 12, 2018). The researchers recommend future studies and contributions across multiple disciplines to achieve a safe and viable solution for treatment options. While studies have been conducted regarding SSRI use and aviation safety, there has not been a significant amount of research conducted across multiple disciplines to demonstrate a definitive link whether SSRI use in airmen has any detrimental effects on aviation safety (Ross et al., 2007).

Recommendation 3. Programs such as BasicMed are currently being used by a few countries and have known loopholes in the system regarding tracking medical history and identifying potential problems in pilots. ICAO has concerns that airmen certified with BasicMed are not being adequately tracked, and governing authorities may not understand the breadth of the medical condition for a given airman (A. Jordaan, personal communication, July 12, 2018). Therefore, the researchers recommend that ICAO thoroughly review State alternative medical certification programs such as BasicMed. ICAO should develop recommended standards, practices, and policies that States can or should follow when implementing alternative certification and treatment programs. This should also include plans for implementing an acceptable tracking system for these programs.

Recommendation 4. The researchers recommend the FAA consider additional medications or treatment options for applicants. In addition, the FAA should consider modeling a program similar to that of Transport Canada. For additional medications to be considered and accepted by the FAA, more research will be required. ICAO does not offer guidance or make recommendations to other ICAO States regarding medications. Therefore, the researchers recommend that ICAO consider issuing further guidance for States that focuses on approving medications and viable treatment options. The researchers also recommend ICAO emphasize the importance of States reviewing research conducted by industry organizations such as AsMA, and other State research initiatives.

Recommendation 5. The researchers recommend that collaboration across multi-state agencies and ICAO is necessary to devise an acceptable data tracking system to help evaluate accident rates and pilot compliance with medical certification and reporting standards. System unification should be required, and this data will also assist in further research initiatives and the administration of policy. Results from this research study have indicated that understanding the breadth of non-compliance among pilots as an issue. Furthermore, ICAO has valid concerns regarding programs such as BasicMed which lack a tracking system or a governing body's ability to be made aware of certain medical conditions.

Future Research & Concluding Remarks

It may take several years to develop viable solutions to many of the issues and concerns presented in this research study. For future success, it is the researchers' opinion that the FAA will need to demonstrate more openness not only with internal changes but in recommended practices from ICAO and other ICAO States. Pilots have a fear of potentially losing medical and flight privileges, which could bring an end to a career. Thus, it is understandable that apprehension causes individuals to contemplate non-disclosure of medical information.

This research study has identified the need for continued research regarding mood disorders in aviation. This research study also identified the need for expanded population samples as well. For example, roughly 21% of the preferred sample pilot population participated in this study. Furthermore, due to time and availability, only one non-aviation medical physician was able to participate. Future research will assist in identifying whether the results of this study can be observed across a broader spectrum of participants.

The FAA, ICAO, and other ICAO States have always made the concerted effort to improve safety in the aviation industry. These agencies continue to encourage pilots to come forward with known medical issues including mood disorders. However, there has to be greater assurances that the agencies are not solely interested in punishing individuals for suffering from any medical condition. As noted by Dr. Anthony Evans and Dr. Sally Evans, creating policies aimed at effective treatment and monitoring those taking antidepressants is far better than those which penalize and ground pilots for seeking or requiring treatments (Werfelman, 2008).

References

Anxiety and Depression Association of America (ADAA). (2016). About ADAA: Facts and statistics. Retrieved from https://www.adaa.org/about-adaa/press-room/facts-statistics

Bor, R., Field, G., & Scragg, P. (2002). The mental health of pilots: An overview. *Counseling Psychology Quarterly*, 15(3), pp. 239-256. doi: 10.1080/09515070210143471

Diamond, L. M. (2018, August 1). The journey of the serotonin reuptake inhibitor in aviation. Retrieved from https://pilot-protection-services.aopa.org/news/2018/august/01/the-journey-of-the-serotonin-reuptake-inhibitor-in-aviation?utm_source=eBrief&utm_medium=email

Federal Aviation Administration (FAA). (2010). Press release-FAA proposes new policy on antidepressants for pilots. Retrieved from http://webcache.googleusercontent.com/search?q=cache:limFwjv8apYJ:www.faa.gov/news/press_releases/news_story.cfm%3FnewsId%3D11293%26amp%3Bamp%3Bprint%3Dgo+&cd=1&hl=en&ct=clnk&gl=us. Also retrieved from https://www.faa.gov/news/press_releases/news_story.cfm?newsId=11293

Federal Aviation Administration (FAA). (2017a). Advisory Circular 68-1: Alternative pilot physical examination and education requirements. Retrieved from https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_68-1.pdf

Federal Aviation Administration (FAA). (2017b). US civil airmen statistics: Annual statistics. Retrieved from https://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/

Flight Safety Foundation (FSF). (2001, January-February). Regulations allow pilots with depression to fly after successful treatment. *Human Factors & Aviation Medicine,* 48(1), pp. 1-6.

Flight Safety Foundation (FSF). (2016, March 17). FSF statement on Germanwings accident report. Press release, sabotage/intentional acts, 2016 FSF press releases. Retrieved from https://flightsafety.org/fsf-statement-on-germanwings-accident-report/

Government Publishing Office (GPO). (n.d.). About the code of federal regulations: What is the code of federal regulations? Retrieved from https://www.govinfo.gov/help/cfr

Healthline. (2017). Depression facts & statistics 2012 infographic. Retrieved from http://www.healthline.com/health/depression/statistics-infographic

International Civil Aviation Organization (ICAO). (2008). Manual of civil aviation medicine preliminary edition: Part III. Medical assessment (Doc 8984-AN/895). ICAO: Montreal

Jackson, K. (2010, December). Evolving medical standards: Showing courage, the FAA allows certain antidepressants. *Business & Commercial Aviation,* p. 66.

Lott, A. P., & Stenson, A. (n.d.). What is anxiety: Types of anxiety. Retrieved from https://www.anxiety.org/what-is-anxiety

Nicholson, A. (2003, November). Anti-depressant use by aircrew: Modulation of higher nervous function and the sleep-wake continuum. *Aviation, Space, and Environmental Medicine,* 74(11), pp. 1205-1206.

Nowak, R. (2007, November 29). Pilots on antidepressants pose no safety risk. *New Scientist.* Retrieved from https://www.newscientist.com/article/dn12981-pilots-on-antidepressants-pose-no-safety-risk/

Paul, M., Gray, G. W., Love, R. J., & Lange, M. (2007, July). SSRI effect on psychomotor performance: Assessment of Citalopram and Escitalopram on normal subjects. *Aviation, Space, and Environmental Medicine,* 78(7), pp. 693-697.

Persaud R., & Bruggen, P. (2015, August 15*).* Beware of the witch-hunt: Depression, pilots and air crashes. After recent tragedies: Should a history of depression preclude pilots flying? *Psychology Today.* Retrieved from https://www.psychologytoday.com/us/blog/slightly-blighty/201508/beware-the-witch-hunt-depression-pilots-and-air-crashes

Presenter, Evans, A. (2013, November). Mental health/depression in aviation [PowerPoint presentation]. Delivered at the meeting of the International Civil Aviation Organization (ICAO), Bucharest, Romania. Retrieved from https://pdfs.semanticscholar.org/presentation/adfe/986660f7512a16fe2ee68afd5d0bcd4a00b9.pdf

Presenter, Hutchinson, E. (2013). A change of mood: UK CAA experience of assessing pilots with treated depression [PowerPoint presentation]. Delivered at the meeting of Aerospace Medical Association (AsMA), Chicago. Retrieved from http://asmameeting.org/asma2013_mp/pdfs/asma2013_present_447.pdf

Ross, J., Griffiths, K., Dear, K., Emonson, D., & Lambeth, L. (2007). Antidepressant use and safety in civil aviation: A case-control study of 10 years of Australis data. *Aviation, Space, and Environmental Medicine,* 78(8), pp. 749-755.

Schomerus, G., Stolzenburg, S., & Angermeyer, M. C. (2015, September 15). Impact of the Germanwings plane crash on mental illness stigma: Results from two population surveys in Germany before and after the incident. *World Psychiatry,* 14(3), pp. 362-363. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1002/wps.20257

Sen, A., Akin, A., Canfield, D., & Chaturvedi, A. (2007). Medical histories of 61 aviation accident pilots with postmortem SSRI antidepressant residues. *Aviation, Space, and Environmental Medicine,* vol. 78, no. 11.

Stoutt, G. (n.d.). Depression: A recoverable stall. *Just for the health of pilots.* Retrieved from https://www.faa.gov/licenses_certificates/medical_certification/hop/media/depression.pdf

Transport Canada. (2018). TP 13312-Handbook for civil aviation medical examiners. Retrieved from https://www.tc.gc.ca/eng/civilaviation/publications/tp13312-2-menu-2331.htm#psychiatry-ssris

Werfelman, L. (2008, February). Antidepressants in aviation. *Flight Safety Foundation*: *AeroSafety World*, pp. 24-27. Retrieved from https://flightsafety.org/wpcontent/uploads/2016/12/asw_feb08_p24-27.pdf

Collegiate Aviation Review International

Volume 37 | Issue 2 Peer-Reviewed Article #6

8-5-2019

Explicit, Implicit, and Blended Vocabulary Instruction: Efficiency in an Aviation English Course

Inna Fainman
The Flight Academy of the National Aviation University

Yevheniia Tokar
The Flight Academy of the National Aviation University

This paper reports on the results of vocabulary teaching sessions in an Aviation English Course conducted with three different groups of 12 fourth-year undergraduate students at the Flight Academy of the National Aviation University in Ukraine. The research objective was to identify how the explicit, the implicit, and the blended instruction influenced the students' progress in Aviation English vocabulary acquisition. Experimental data was analyzed following the grounded theory approach. Each group took a pretest, a post-test, and a delayed test. The results showed that all three types of vocabulary instruction had a positive effect on the learning and recall of aviation vocabulary. The students who received the explicit treatment statistically outperformed the other two treatment groups in the posttest, based on immediate word acquisition. The results of the delayed test demonstrated that blended instruction was the most efficient approach in terms of delayed vocabulary retention as compared to a solely implicit or explicit teaching method. Therefore, we conclude that Aviation English classroom practices should incorporate a balanced approach employing both implicit and explicit vocabulary instruction.

Recommended Citation:

Fainman, I. & Tokar, Y. (2019). Explicit, Implicit, and Blended Vocabulary Instruction: Efficiency in an Aviation English Course. *Collegiate Aviation Review International,* 37(2), 110-132. http://dx.doi.org/10.22488/okstate.19.100218

Lexical competence is crucial to foreign language proficiency. The vocabulary of a language is just like the bricks used to construct a building. McCarthy (1990) stated "it is the experience of most language teachers that the single biggest component of any language course is vocabulary" (p. viii). Vocabulary is a key to effective communication, i.e. it is needed to convey the meaning and comprehend the idea when listening and reading.

Furthermore, McCarthy (1990) argued that "no matter how well the student learns grammar, no matter how successfully the sounds of a foreign language (L2) are mastered, without words to express a wide range of meanings, communication in an L2 just cannot happen in any meaningful way" (p. viii). Therefore, it is clear why linguistic and methodological issues of vocabulary teaching have become of particular value.

Aviation English is used in professional communication where a lack of the necessary lexical skills can lead to miscommunication, or cause fatal accidents. Searching for the most efficient ways of teaching Aviation English vocabulary is of paramount importance.

Nonetheless, there is no consensus among the researchers concerning greater productivity and efficacy of some instructional practices over the others. Beck, McKeown and Omanson (1987) emphasized, that "research has provided much useful information about vocabulary learning and instruction. What it has not provided is a simple formula for optimal instruction, because no such formula can exist" (p. 150). However, researchers still strongly argue on which instructional method—implicit or explicit—yields more effective lexis acquisition. A number of linguists (Cunningham, 2005; Stahl, 2005) support the use of deliberate regular instruction alongside with multiple exposures, thus aiming at effective vocabulary development. On the other hand, Newton (1995) and Nation (2001) opt for implicit instruction, which requires rich contexts to expand the vocabulary. Both approaches definitely have certain advantages as well as some shortcomings, while there is a suggestion that "vocabulary is neither the exclusive domain of implicit nor that of explicit learning but it is rather associated with both and the two modalities interact with and influence each other" (Souleyman, 2009, p. 48). As Schmitt (2000) stated, the best vocabulary acquisition method is "a proper mix of explicit teaching and activities from which accidental learning can occur" (p.145).

This paper brings together suggestions from a varied body of research on L2 and English for Specific Purposes (ESP) vocabulary learning and discusses the peculiarities of explicit, implicit and blended vocabulary instruction. It provides insight into teaching vocabulary in the Aviation English Course and finally presents the study, comparing the learning outcomes of explicit, implicit and blended aviation vocabulary instruction to three groups of learners.

Literature Review

Specialized Vocabulary: Why it is Important in an Aviation English Course

The Aviation English Courses taught at colleges and universities can generally be regarded as English for Specific Purposes. ESP is a blanket term used for a variety of spheres. According to Strevens (1988),

> ESP is designed to meet specific needs of the learner. (…) The language taught to the ESP learners is related in content (themes and topics) to the professional context it is going to be used in. (…) Moreover, the language needed in these activities is in the center of the course, and it covers all the language needed by the learner in order to function in a given work environment (p.4).

Consequently, specialized vocabulary composes an essential part of an ESP course to serve the needs of students since second and foreign language learners feel the necessity for a large lexical corpus to cope with their studies and further work in academic or professional environments.

Aviation vocabulary is crucial in an Aviation English Course for a number of reasons. Some of them are common to all the ESP areas whereas others deal with the specific peculiarities of this certain sphere.

First, aviation vocabulary is highly important for future aviators because knowledge of the specialized vocabulary of any field is tightly related to content knowledge of the discipline. In a longitudinal study of undergraduate students' academic writing Woodward-Kron (2008) wrote,

> The specialist language of a discipline is intrinsic to students' learning of disciplinary knowledge; students need to show their understanding of concepts, phenomena, relations between phenomena etc. by incorporating the specialist language and terminology of their discipline into their writing accurately. They also need to adopt the specialist language in order to make meaning and engage with disciplinary knowledge (p.246).

Secer and Sahin (2014), focusing on challenges of teaching aviation vocabulary and radio phraseology at the high school level, stated that "teaching the meaning and the usage of the technical vocabulary contributes a lot to the learning of the content area" (p.111).

Secondly, this engagement with disciplinary knowledge and vocabulary is significant because it signals the belonging to a community which shares the same concepts and understandings of a field (Wray, 2002). "Specific purpose language is precise, has distinctive features (lexical, semantic, syntactic or even phonological) which make it peculiar and understandable only in the environment of its users" (Douglas, 2000, p. 7). In other words, specialized vocabulary makes the language of the air transportation professional environment absolutely impenetrable for a layman.

The third, and probably most substantial, reason for the prime importance of aviation vocabulary lies within the main conceptual value of the sphere—transportation safety. Effective, clear and reliable communication between a pilot and an air-traffic controller is a vital element of safe air-traffic control (Kolosov & Ivanova, 2000, p.90).

The International Civil Aviation Organization (2010) explains: "With mechanical failures featuring less prominently in aircraft accidents, more attention has been focused in recent years on human factors that contribute in accidents. Communication is one human element that is receiving renewed attention" (p. vii). English is a working language in international aviation and mutual intelligibility for both native and nonnative English speakers is the main purpose of language cooperation between the participants in the air transportation sphere. In any communication situation within aviation discourse (which mostly involve the knowledge of ESP vocabulary, i.e. aviation specialized word store), even the most perfect knowledge of English is not enough to succeed in the communication process. Being a native speaker of English does not guarantee proficiency in Aviation English.

Aviation English vocabulary constitutes the core of the communication in the professional aviation environment, thus directly influencing its efficiency and security. If communicators lack specialized vocabulary, they tend to apply communicative strategies to avoid using these words which is completely inacceptable and disastrous in aviation due to its highly regulated language means usage.

Teaching Aviation Vocabulary

Dudley-Evans and St. John (1998) are of the opinion that teaching ESP vocabulary is defined by the same principles as teaching English vocabulary for general purposes, just as if in a L2 course. Therefore, general pedagogy and basic ideas on learning and teaching ESL vocabulary are well-applicable in the overview of Aviation English vocabulary acquisition. Nevertheless, given the nature of this specialized vocabulary, "the treatment of vocabulary in ESP courses may in some ways be more challenging than in general purpose English courses" (Hirvela, 2013, p.84). For instance, Coxhead (2013) emphasized that there are everyday words with specialized meanings and they "could present difficulties for teachers as learners struggle to learn new meanings and concepts for words that are already established in their lexicon in a particular way" (p.127). Thus, vocabulary instruction in ESP courses, and Aviation English as well, requires a well-planned and consistent method to help students cope with all the challenges they might face and eliminate possible difficulties for Aviation English teachers.

The authors are strongly convinced that acquiring new lexis for professional communication has to be systematic, logical and planned rather than spontaneous and extemporaneous. Since the civil aviation communication environment is well defined and requires the knowledge and usage of particular lexical items, relying only on incidental acquisition is not reasonable. The authors do not deny the potential value of unconscious or uncontrolled vocabulary learning, but being usually incidental and unsystematic, it is unlikely to develop deep and profound lexical skills proficiency. The authors admit targeted instruction has to be well-planned and stated clearly in syllabi, lesson plans and curricula. On the contrary, learning cannot be mandated - students are directed to study, but the act of learning is more of an internal process. However, according to Petty, Herold and Stoll (1968) using any vocabulary instruction is certainly better than no instruction at all. Sticking to any vocabulary teaching plan is more likely to be productive than spontanious and rash practices *Thus, any Aviation English Course is certainly planned* to systematically cover a certain scope of *vocabulary. However, the consideration is what approaches a teacher should adhere to and what methods and strategies he/she chooses to apply in each class in order to achieve the goals and satisfy the learner's needs.*

The previous publication (Fainman & Tokar, 2018) followed Graves, August and Mancilla-Martinez'(2013) ideas and worked out a four-component vocabulary teaching program for an Aviation English Course. The authors admit the need to involve students in implicit vocabulary expansion through reading and listening along with targeted, systematic and consistent vocabulary acquisition on the basis of an explicit teaching instruction. "From an educational point of view, incidental and intentional vocabulary learning should be treated as *complementary* activities which deserve both to be practiced" (Hulstijn, 2001, p. 272).

It is essential not solely to encourage students to devote much time to reading or listening to professional topics, because this is not sufficient to acquire the necessary lexical items, but it is also important to involve them in the reading and listening to subject-related tasks which would as well stimulate word encoding and processing in context. Exposure to language input does not necessarily result in effective vocabulary acquisition. The input must be easy to process and a richly meaningful context provides the best chance for the development of lexical knowledge. "Each successful encounter with a word increases the strength of the mapping between each word form and its different meaning and uses" (Barcroft, 2015, p. 35).

Furthermore, Sternberg (1987) emphasized the necessity of theory-based instruction concerning the importance of meaning inferring processes. This means students will definitely enrich their vocabulary if they are familiar with word-learning strategies and the role of word structures. Thus, teaching strategies for expanding vocabulary and developing students' learning skills, as well as promoting their awareness of subject-specific lexis and its importance in aviation have to be an essential supplementary part of the effective vocabulary teaching program.

Thus, the following four components of vocabulary teaching program in an Aviation English Course have been defined (Fainman & Tokar, 2018):

1. Explicit teaching of selected lexical items
2. Implicit vocabulary teaching by exposure to relevant comprehensible input
3. Teaching word-learning strategies
4. Fostering word consciousness.

The four-component vocabulary teaching program as discussed is quite comprehensible. However, there is a practical question which remains unsolved in Aviation English pedagogy: Which instruction, explicit or implicit, or a combination of both, is preferable in order to provide the most effects on students' vocabulary learning and retention?

Explicit, Implicit and Blended Vocabulary Instruction in an Aviation English Course

The instruction type is an important contributor to the development and consolidation of vocabulary knowledge. On the basis of the detailed analysis of current pedagogical studies (Hulstijn, 2001; Laufer, 2009; Nation & Webb, 2011; Schmitt, 2008; Sökmen, 1997) the distinction between explicit and implicit vocabulary learning has been elaborated in the background of this research. Methodologically, the difference is essential for any researcher intending to design a vocabulary learning experiment (Hulstijn, 2001). Herein, the authors suspect that the three kinds of vocabulary instruction under study will differently affect the result of students' vocabulary learning and retention of the target words in an Aviation English Course.

The emphasis of *explicit vocabulary instruction* in this research is on the implementation of the direct teaching of targeted vocabulary; students are informed that they will be tested on specific lexical items that are then taught explicitly. Explicit vocabulary instruction refers to a vocabulary learning activity where the learners consciously and intentionally learn the target vocabulary, such as when a student completing certain tasks is informed of the principal objectives, singles out new lexemes, focuses on them and resorts to a number of meaning inferring strategies.

Implicit vocabulary instruction refers to teaching lexical items involving students' vocabulary learned through an activity in which the new lexical items are mastered without the learners' being conscious of it, in particular during reading or oral communication, or as a secondary result of an activity. This is an automatic operation, characterized by limited premeditation. In the process of implicit vocabulary teaching, students get new vocabulary from the context, though they did not mean to do so. Thus, students concentrate on comprehending the general contents of the written text or the video, lexis enhancement becomes the natural outcome of this activity and a focused intention to learn is not needed. Grounded on this assumption, in this study, the implementation of implicit vocabulary instruction presupposes no attraction of students' attention to specific language aspects or lexical units in the video, listening or reading tasks.

However, the authors do admit that for the most part teaching vocabulary is not limited to the use of purely implicit or purely explicit methods. Vocabulary instruction varies significantly; the methods used can be greatly explicit as well as distinctly implicit, depending on a number of factors. Moreover, students function under an explicit condition when reading or listening to a piece of information with the purpose of answering the forthcoming questions concerning the contents, but they simultaneously function under an implicit condition as they are exposed to unknown words not expecting any monitor procedures or checks of these words.

One objective of this paper is to distinguish explicit and implicit vocabulary teaching in terms of the use of pre-learning instructions that either do or do not forewarn about the objective of the activity (such as learning a corpus of new lexical items) and the existence of a subsequent vocabulary retention test.

A number of experiments have already been conducted and further described in scientific publications as for L2 vocabulary teaching, but the researchers disagreed as to whether implicit or explicit approaches were more efficient. Thus, Zimmerman (1997) emphasizes the principle benefits and claims that implicit vocabulary teaching is highly connected with the context (a student learns about the meaning of a word and its usage) and it involves a learner into two kinds of activity at the same time— he/she reads (listens to/ watches) and enriches his/her vocabulary. Nevertheless, implicit instruction has its shortcomings. It may take students quite a considerable amount of time to guess the meaning from the context. Concerning this fact, Zhang (2008) noted that "heavy reliance on L2 vocabulary acquisition through inferring words from context seems to be a slow process. In natural contexts, incidental L2 vocabulary learning does not seem to contribute a lot to vocabulary retention" (p. 30). Moreover, the guesses may not always be correct or accurate enough (Huckin & Coady, 1999; Mukoroli, 2011), thus making the process of word acquisition not efficient.

Dakun (2000), dwelling upon the advantages of explicit vocabulary teaching, emphasized that in this way learners can use cognitive and metacognitive strategies which can facilitate their efforts. Schmitt (2000) stated that "certain important words make excellent targets for explicit attention, for example, the most frequent words in a language and technical vocabulary", while emphasizing that "some explicit learning is probably necessary to reach a vocabulary size 'threshold". At the same time the researcher has not denied it is "time-consuming and... too laborious" (p. 120-121). Nagy (1997) emphasized that the amount of words in a language is quite considerable and goes further, stating that direct vocabulary teaching is time wasting. However, the researcher acknowledged that the minor part of the vocabulary could be acquired more effectively by means of explicit instruction. Nation (2001), on the contrary, supported the idea of explicit vocabulary learning, emphasizing that the time spent on the process is worth it.

Since 2000, more and more L2 pedagogy researchers have started focusing on blended vocabulary instruction, stressing that implicit and explicit teaching should not be seen as opposing each other but as complementary activities. Sökmen (1997) has presented facts that the usage of solely implicit teaching methods will not invariably result into learning, and underlines "the need to accompany it with a much stronger word level or bottom up approach than had been previously advocated" (p. 239). The author has recognized that it is "worthwhile to add explicit vocabulary to the usual inferring activities in the second language classroom" (p. 239).

This research defines *blended vocabulary instruction* as the approach that combines aspects of both implicit and explicit vocabulary teaching in the act of involving students in the lexis acquisition process and can be described as an instruction which presupposes the use of a few treatment schemes for the purpose of improving the acquisition results. Herein, different sequences and combinations of tasks and

actions might be possible. For instance, providing meanings for a part of novel words can come first and then be followed by completing a reading or listening problem-solving task which presupposes inferring meaning for a number of non-presented lexical items; or some post-reading tasks are organized to explicitly focus on target words.

Contrary to the existence of multiple EFL studies, ESP pedagogy is not really rich in research and experimental evidence on the efficiency of either explicit, implicit or blended vocabulary instruction. A thorough review of related literature has discovered that very little research has been conducted on examining which kinds of vocabulary teaching approaches are the most effective in ESP classes. Kusumawati and Widiati (2017), having conducted an experiment, stated that explicit vocabulary teaching in English for engineering courses leads to better results than implicit teaching. Ozola (2015) dwelled on using audio materials for ESP vocabulary acquisition and on the basis of a case study found implicit lexis teaching to be rather efficient. Nevertheless, to the best knowledge of the researchers, no studies at the international level have been conducted investigating the impact of applying explicit, implicit and blended vocabulary teaching strategies so as to improve an Aviation English Course. Therefore, this study is expected to be an effort in the right direction in investigating the influence of vocabulary instruction type on the students' progress in Aviation English lexical competence.

Certain conditions need to be outlined for our research. It cannot be really objective without taking into consideration the factors which directly affect the efficiency of the teaching process. The authors accept the viewpoint (Takač, 2008) that the role of the implicit vocabulary instruction, such as exposure to multiple language contexts, in the initial stages of vocabulary learning is relatively negligible. Beginners do not have enough linguistic knowledge which is critical for success of contextual inferencing. Besides, more than language competence is needed to understand aviation texts. It is possible for a student to know all the words in a passage and still not make any sense of it if he has no prior knowledge of the topic. To make constructive use of vocabulary the student also needs a threshold level of knowledge about the topic. This enables him to make sense of the word combinations and choose among multiple possible word meanings (Hirsch, 2003). Since the Aviation English Course presupposes learners' specific professional needs and in Ukraine they usually take the course within a complex higher education training program, without having any prior background knowledge in this area, we realize that there is very little influence of implicit vocabulary instruction at the beginning stages of the Aviation English Course. Thus, our research involves only the later stage which covers the third and the fourth years of teaching Aviation English.

Method

Participants

The participants of the study were selected from among the fourth-year undergraduate students at the Flight Academy of the National Aviation University in Kropyvnytskyi, Ukraine. All were native speakers of Ukrainian and Russian and had at least 5 years of experience studying general English at secondary schools. All of the students passed the External Independent Evaluation Exam in English when leaving school and overcame the threshold level of 124 points.

All the participants had been studying English at the academy for three years and had taken the same number of courses. They took part in a pretest which was used to check the homogeneity of the group in terms of their proficiency level. According to the results from the pretest, three out of the five groups of students were selected for this pedagogical experiment as those that turned to be most homogeneous. All of the participants were males. They varied in age from 20 to 22 years and were all initially at about the same level of Aviation vocabulary proficiency. Each group consisted of 12 students. Thus the total number was 36.

Limitations of the study

First of all, the authors acknowledge that one of the limitations of this study was the low number of participants—only 36 students overall with 12 students in each group. The lack of representation of population may result in a kind of sampling error, but the number of students chosen was the only possible option predetermined by several reasons. The academy takes only 4-5 groups of students for pilots' training every year, as it is rather costly and requires special technical facilities. A maximum of three groups could be included in the research to maintain homogeneity. As the only institution of its kind in Ukraine, it was impossible to involve more students in the experiment. Thirdly, the authors could not implicate foreign students studying at the Flight Academy, unfortunately. We are strongly convinced that for the sake of providing true results only homogenous groups of students could take part in the experiment. The fact is all the Ukrainian students pass External Independent Evaluation Test in English before entering the Academy and get not less than 124 points, while foreign students do not take the same examination. What is more, foreign students constitute separate groups and study separately from Ukrainian students, though covering the same curriculum. Thus, their level of English might be significantly lower or higher when getting to the academy or even after 3 years of studying. These implications have been as well backed up by the results of the pre-test, since the group of foreign students turned to be not homogenous in terms of their proficiency level and that is why was not designated in the research.

In addition to the limitations described, the study was conducted within a relatively short, 6-hour period of time, covered one vocabulary topic, and spanned three classes. While a profound research, covering vocabulary acquisition within more than one topic, would be more impressive and powerful, the authors plan to include this in future scientific projects.

Finally, the participants were only undergraduate students already having a certain level of background knowledge in aviation, aerodynamics, meteorology, and other relevant topics.

Materials and validity of the instruments

The authors prepared the pretest, the posttest and the delayed test . For the sake of validity the tests were given to a group of Aviation English experts at the Flight Academy of the National Aviation University (Kropyvnytskyi, Ukraine) to examine for test accuracy and adequacy. The group consisted of five associate professors who all teach Aviation English Courses. The authors received their critical reviews and made all the necessary modifications according to the comments mentioned.

All three tests used various question types—gap filling, multiple choice, matching, word building, and others—setting primary focus on the target vocabulary. The sample of the post-test is presented in Appendix A. Before the research execution phase all the tests had been piloted to provide the clarity of the instructions and evaluate the timing of each task.

Authentic texts on the professional topic containing the selected target vocabulary as well as the corresponding audio-visual materials were chosen for implementing the teaching program.

Data collecting technique

The data collecting technique in this research was conducted in several steps as follows:

1. All of the participants (N=36) were asked to take the pretest, which was administered one week prior to the study. The pretest was carried out to make sure that the target words in

this experiment were unknown to all students. On the whole there were 33 target words relating to the topic (see Appendix B).

2. One week after the pretest, the researchers began the session for each group which required three regular classes covering one topic according to the teaching program (One class = 80 minutes). The detailed steps of treatment in the explicit, implicit and blended groups will be explained later within this paper.
3. Two days later in the next class a posttest (on those 33 target words) was conducted to measure students' immediate vocabulary mastery.
4. A delayed test after two weeks from the treatment was carried out to measure students' vocabulary retention.

Experimental Manipulations

The explicit vocabulary instruction. The explicit vocabulary instruction of target words was carried out in accordance with the procedure thoroughly described by Tokar & Fainman (2018). All 33 vocabulary units were presented by the teacher; meanings were conveyed using visual methods (demonstrating objects, pictures, movements, etc.) and through context or illustrative sentences, definitions or comparison. The teacher addressed the word form (pronunciation and spelling) and worked on the possible word collocations first. After that, multiple exposures to targeted words (such as practising word recognition or production in different kinds of collocations, entences and texts) were provided. Finally, this was followed by active involvement in different kinds of speech acts, short dialogues and monologues by means of a variety of practical tasks and exercises.

The implicit vocabulary instruction. In the implicit group, the students' only job in the session was to comprehend the general storyline or the message. The target words were neither presented by the teacher, nor were their meanings conveyed.

The students were asked to concentrate on the texts, videos or recordings with no explicit vocabulary instruction prior or later. Moreover, the teacher did not ask them to consider any specific lexical items or expressions, so the students did not really realize there were any words to memorize from the materials.

The instructor nudged the learners to grasp the subject matter of the videos, texts and recordings by giving hints relating to the content, but in a restricted manner. The instructor did not purposefully focus on the meaning of particular words.

After reading a text, listening to a recording or watching a video the participants fulfilled the tasks where they were to match the parts of the sentences, tick true or false sentences, discuss the possible pilot's actions in the situations presented. The authors did not inform the students of the forthcoming posttest and the delayed test as well, because such kind of notice is in no way entailed by implicit teaching methods.

The blended vocabulary instruction. The blended vocabulary instruction as described earlier presupposed combining aspects of both implicit and explicit instructions with the intention of facilitating vocabulary learning. Thus, the researchers randomly selected 17 vocabulary items to be learnt explicitly partly in pre-reading (pre-watching/listening) and partly in after-reading (after-watching/listening) activities and the other 16 items for implicit acquisition. In spite of the difference in the delivery mode, the texts and audio-visual materials used for blended vocabulary instruction remained the same as in the other two experimental groups.

Thus, in the pretasks before reading the texts, watching a video or listening to a piece of information, as well as in the activities afterwards, the teacher paid special attention to the words that were meant to be learnt explicitly. Their meanings were conveyed directly, students were involved in work with word forms, collocations, and usage. As for the vocabulary units for implicit instruction, fulfilling the corresponding tasks, the students did not realize the necessity to memorize the words; they were rather focused on getting the general ideas of the proposed texts, videos and audio recordings. The tasks completed before and after reading, listening and watching the aforementioned materials in no way attracted the students' attention to particular target words, though the teacher could give students clues or direct their actions to understand their meanings with the help of True or False exercises, questions with synonymic or paraphrased vocabulary items.

The authors did not inform the students of the future immediate and delayed tests. The authors considered it inappropriate, as the new vocabulary units were delivered through partly-explicit and partly-implicit instructions. However, the authors believe that the students expected an immediate posttest, at least on vocabulary units that were taught explicitly, as such kinds of tests are usually conducted in an explicit approach.

Results and Discussion

The present study set out to explore the effects of applying implicit, explicit and blended vocabulary instruction in the Aviation English Course for the fourth-year undergraduate students. First, the pretest was conducted in order to identify the initial vocabulary knowledge of the students before the experiment itself. The total maximum, possible to get, was 100 points. The data obtained from the pretest is presented in Table 1.

Table 1
Descriptive Statistics of the Pretest Data

Group	N	Minimum	Maximum	Range	Mean Score	Std. Dev.
Implicit VI	12	2	19	17	8.58	5.13
Explicit VI	12	0	17	17	9.42	5.07
Blended VI	12	4	16	12	9.17	3.66

The students were shown to have no significant proficiency in the vocabulary intended to be taught and the three groups were found to be similar concerning their English target vocabulary knowledge levels at the beginning of the intervention. Based on Table 1, the students' scores in the implicit vocabulary instruction (IVI) group appeared to be between 2 and 19. Thus, the range and the standard deviation were 17 and 5.13, respectively. Meanwhile, the students' scores in the explicit vocabulary instruction (EVI) group showed that the interval ranged from 0 to 17, and the standard deviation was 5.07. The blended vocabulary instruction (BVI) group turned to have a maximum students' score of 16 points and the minimum one of 4, with the range of 12 and the standard deviation of 3.66. See Figure 1 for the mean scores of the IVI group, EVI group and BVI groups.

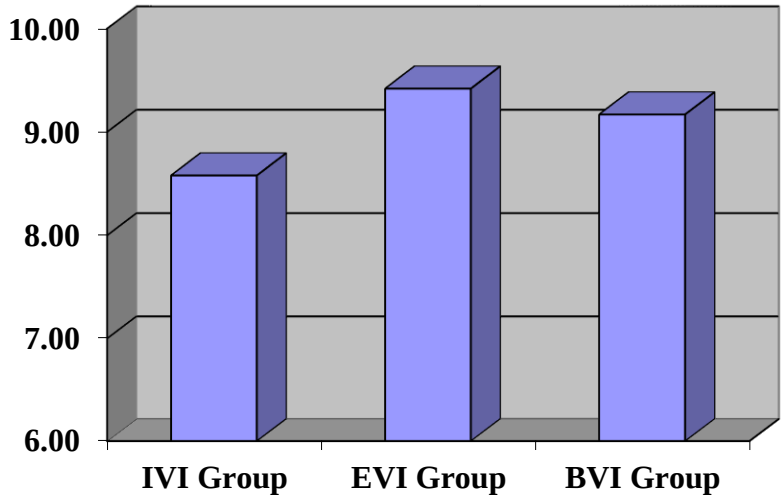


Figure 1. The Pretest Mean Scores of the Treatment Groups

The mean scores of these three groups were verified through a one way analysis of variance (ANOVA) and proved to have no statistically significant difference, thus being equal before the intervention. $F = 0.1$, whereas $F_{cr} = 2.47$ for $P \leq 0.01$. *Thus,* $F_{emp} < F_{cr}$, i.e. the difference between the groups before the experiment is statistically insignificant.

During the experiment session 33 vocabulary items were taught implicitly, explicitly, and via blended instruction to the three groups of students respectively. All of the words were chosen from the same teaching material. A 100-points test was administered as the posttest to the same groups after the teaching process. The goal was to compare the groups' progress in their vocabulary knowledge. The results gained in posttest are presented in Table 2.

Table 2
The Descriptive Statistics of the Posttest Score

Group	N	Minimum	Maximum	Range	Mean Score	Std. Dev.
Implicit VI	12	48	74	26	63.17	7.87
Explicit VI	12	64	95	29	79.41	10.39
Blended VI	12	62	93	31	79.0	9.80

The students gained significantly in terms of their aviation vocabulary skills in all the three groups. As shown in Table 2, the students' scores in the IVI group ranged from 48 to 74, with the mean score being 63.17, while the standard deviation was 7.87. The students' scores in the EVI group showed that the interval ranged from 64 to 95 and the standard deviation was 10.39. Meanwhile, the BVI group turned to have maximum score of 93 points and the minimum one of 62, and the standard deviation 9.80.

The EVI group mean score appeared to be the highest (M=79.41, SD=10.39), with the BVI group result slightly lagging behind (M=79.0, SD=9.80) and the IVI group's points being the lowest (M=63.17, SD=7.87). One way ANOVA of the posttest results proved statistically significant difference of the 3 groups of students ($F = 13.88$, whereas $F_{cr} = 2.47$ for $P \leq 0.01$, thus $F_{emp} > F_{cr}$), thus concluding the difference appeared due to the implemented teaching techniques.

The mean scores of the IVI group, the EVI group and the BVI group at the pretest and at the posttest were compared and the difference is illustrated in Figure 2.

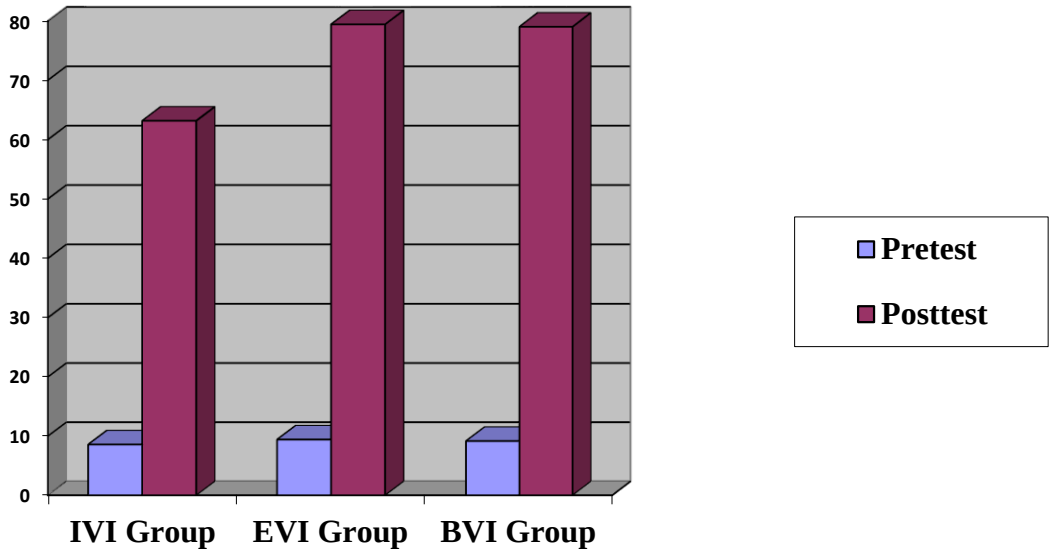


Figure 2. The difference of the mean scores at the pre test and the posttest

As shown, the mean score of the implicit vocabulary instruction group was raised from 8.58 at the pretest to 63.17 at the posttest.The explicit vocabulary instruction group registered the mean score 9.42 on the pretest and 79.41 on the posttest.In its turn, the blended vocabulary instruction group scored a mean of 79.0 on the posttest compared to 9.17 at the pretest. To examine the significance of the pretest and the posttest results' difference, a paired sample t-test was used. Table 3 shows the statistics.

Table 3
Paired Sample T-test Statistics (Pretest vs. Posttest)

Group	N	t	df	Sig.
Implicit VI	12	21.68	11	.000
Explicit VI	12	18.17	11	.000
Blended VI	12	23	11	.000

There was a significant increase in vocabulary knowledge from the pretest to the posttest in each group. The IVI Group pretest M = 8.58, SD = 5.13, posttest M=63.17, SD =7.87, $t(11) = 21.68$, $p < .001$. The EVI Group pretest M = 9.42, SD = 5.07, posttest M=79.41, SD =10.39, $t(11) = 18.17$, $p < .001$.The BVI Group pretest M = 9.17, SD = 3.66, posttest M =79.00, SD =9.80, $t(11) = 23$, $p < .001$. The level of significance was 0.00, less than 0.05, indicating a significant difference between the mean scores of the pretest and the posttest in each group. The difference showed that the students had gained a higher level of aviation vocabulary knowledge having been taught aviation vocabulary during the two-week session.

The results of the study, and the posttest in particular, thus support the earlier findings (Zimmermann, 1997; Ozola, 2015) stating the pedagogical efficacy of implicit vocabulary instruction; they are also in agreement with studies by Dakun (2000) and Nation (2001), who emphasized the

advantages of following an explicit vocabulary teaching approach. More importantly, the learning outcome of blended vocabulary instruction group adds evidence to Sökmen's (1997) statement on the efficacy of combining explicit vocabulary techniques with usual inferring activities in the second language classroom. Therefore, each of the three vocabulary techniques has advantages and leads to significant vocabulary enhancement.

A delayed test was carried out after 2 weeks after the sessions to measure the students' vocabulary retention. The authors would like to lay emphasis here that no other session on the targeted vocabulary was provided within these two weeks. All of the three groups of students continued their Aviation English Course as usual according to the curriculum established. The data obtained from the delayed test is presented in Table 4.

Table 4
Descriptive Statistics of the Delayed Test Data

Group	N	Minimum	Maximum	Range	Mean Score	Std. Dev.
Implicit VI	12	50	72	22	62.5	7.02
Explicit VI	12	61	92	31	77.5	10.18
Blended VI	12	67	96	29	81.16	9.75

As shown, the students' scores in the IVI group were now between 50 and 72, with a mean score of 62.5, while the range and the standard deviation were 22 and 7.02, respectively. The students' scores in the EVI group showed that the interval ranged from 61 to 92 and the standard deviation was 10.18. Meanwhile, the BVI group turned to have maximum score of 96 points and the minimum one of 67, with the range of 29 and the standard deviation of 9.75.

The BVI group mean score now appeared to be the highest (M = 81.16, SD= 9.75), with the EVI Group result slightly behind (M =77.5, SD = 10.18) and the IVI group's points being the lowest (M = 63.17, SD=7.87).

The mean scores of the IVI group, the EVI group and the BVI group at the pretest, the posttest and the delayed test were compared and the difference is illustrated in Figure 3. As shown, the mean score of the implicit vocabulary instruction and the explicit vocabulary instruction groups slightly decreased from 63.17 and 79.41 at the posttest to 62.5 and 77.5 at the posttest respectively, while the blended vocabulary instruction group showed some increase in terms of vocabulary retention, comparing 79.0 mean score at the posttest to 81.16 at the delayed test.

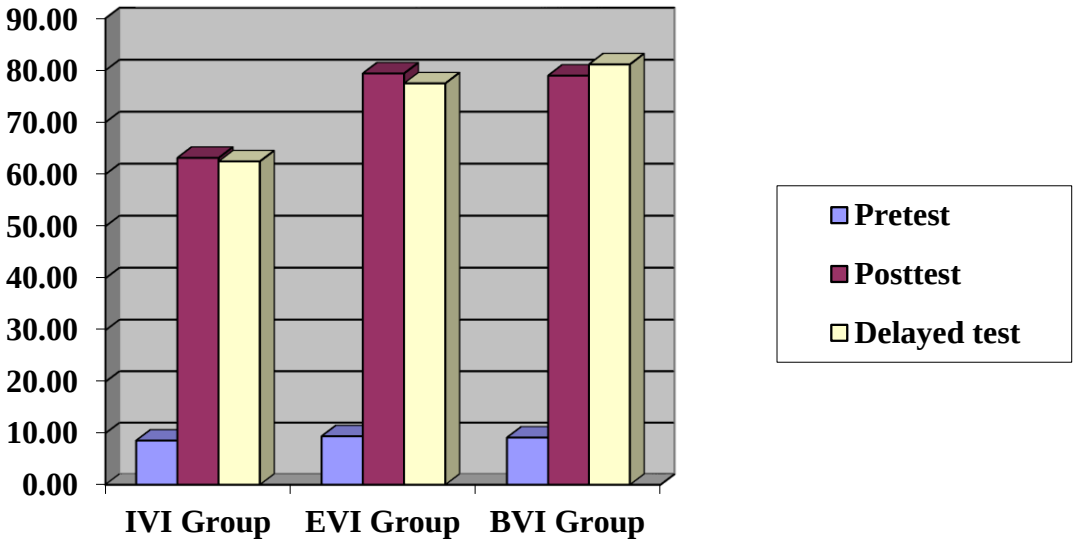


Figure 3. The difference of the mean scores at the pretest, the posttest and the delayed test

The results presented, on one hand, support the claims (Zhang, 2008) that the implicit vocabulary teaching instructions do not turn out to be extremely effective in terms of vocabulary retention, however, on the other hand, they as well disagree with Nation's (2001) statement that spending a significant amount of time on explicit instruction is always worthwhile, since the mean score of the EVI group shows a decrease in the delayed test as compared to the posttest outcome. At the same time the results in the BVI turned out to show a slight increase, thus proving to be the most impactful and powerful.

Overall descriptive statistics for the data obtained in the whole experiment can be visually presented in one form and are given below in Table 5.

Conclusions

This study investigated the effect of explicit, implicit and blended vocabulary teaching approaches on the learning and recall of vocabulary items by aviation students. In the course of the study the three groups of students were taught by means of explicit, implicit and blended vocabulary strategies. The findings of this research agree with other studies that both the implicit and the explicit teaching of vocabulary are effective, but prove that the blended approach is superior to both.

The participants showed an increase from the pretest to the posttest, thus it can be claimed that implicit, explicit and blended vocabulary instructions had a positive effect on the learning and recall of vocabulary. Explicit vocabulary instruction, nevertheless, proved to be more effective regarding immediate word acquisition. However, the results of the delayed test appear to suggest that blended treatment tended to achieve the best results concerning keeping the learnt vocabulary units in memory after a period time. Thus, the combination of both implicit and explicit vocabulary teaching techniques in the act of involving students into lexis acquisition process, the blended instruction for example, was shown to be the most efficient approach for the acquisition of lexical items in the Aviation English Course, whereas either a solely implicit or a solely explicit approach tended to produce less significant delayed results.

Table 5
Overall Descriptive Statistics for the Groups

	Groups	N	Mean score	Std.Dev.	ANOVA	Paired samples *t*-test
Pre-test	Implicit	12	8.58	5.13	$F_{emp} = 0.1$ $F_{cr} = \begin{cases} 3.30\ for P \le 0{,}05 \\ 2.47\ for P \le 0{,}01 \end{cases}$	
	Explicit	12	9.42	5.07		
	Blended	12	9.17	3.66	$F_{emp} < F_{cr} \rightarrow$NS (nonsignificant)	
Post-test	Implicit	12	63.17	7.87	$F_{emp} = 13.88$ $F_{cr} = \begin{cases} 3.30\ for P \le 0{,}05 \\ 2.47\ for P \le 0{,}01 \end{cases}$	$t_{cr} = \begin{cases} 2.20\ for P \le 0{,}05 \\ 3.11\ for P \le 0{,}01 \\ 4.44\ for P \le 0{,}001 \end{cases}$ $t = 21.68$ p-value = .000
	Explicit	12	79.41	10.39	$F_{emp} > F_{cr} \rightarrow$ S(signif.)	$t = 18.17$ p-value = .000
	Blended	12	79.0	9.80		$t = 23$ p-value = .000
Del. test	Implicit	12	62.50	7.02		
	Explicit	12	77.5	10.18		
	Blended	12	81.16	9.75		

To summarize, in the light of the present study, the following implications and recommendations are suggested:

1. All three types of vocabulary instruction provide considerable vocabulary development and thus should be viewed as an indispensable part of language teaching in the Aviation English Course.
2. As far as the pedagogical and methodological implications are concerned, the findings indicate some fundamental imperatives which may affect aviation vocabulary learning and acquisition. The authors conclude that learners should be guided through the balanced amounts of the implicit and explicit vocabulary instruction for the sake of the best learning outcome.
3. Due to the limitations of the study, the authors recommend more detailed research on the efficacy of numerous vocabulary teaching methods and tools in the Aviation English Course. Additional research – both longitudinal and quantitative - will allow future efforts in this area to more fully meet their intended goals and objectives. Furthermore, the authors consider it

necessary to research what vocabulary teaching methods turn out to be more effective for first- and second-year students, while making a more profound analysis of how the teaching strategies should change as students' language proficiency increases.

Finally, these findings and their significance to vocabulary instruction are particularly useful for Aviation English teachers in planning vocabulary activities and also for syllabi and materials developers in preparing textbooks and tasks for language learners.

References

Barcroft, J. (2015). *Lexical input processing and vocabulary learning*. Amsterdam: John Benjamins.

Beck, I. L., McKeown, M. G., & Omanson, R. (1987). The effects and uses of diverse vocabulary instructional techniques. In M. G. McKeown, & M. E. Curtis (Eds.), *The nature of vocabulary acquisition* (pp. 147–163). Mahwah, NJ: Erlbaum.

Coxhead, A. (*2013*). *ESP and vocabulary*. In B. Paltridge & S. Starfield (Eds.), *The handbook for English for specific purposes* (pp. 115-132). Chichester: Wiley-Blackwell.

Cunningham, A. E. (2005). Vocabulary growth through independent reading and reading aloud to children. In E. H. Hiebert & M. L. Kamil (Eds.), *Teaching and learning vocabulary: Bringing research to practice* (pp. 45–68). Mahwah, NJ: Erlbaum.

Douglas, D. (2000). *Assessing languages for specific purposes*. Cambridge: Cambridge University Press.

Dudley-Evans, T., & St. John, M. J. (1998). *Developments in ESP: a multi-disciplinary approach.* Edinburgh: Cambridge University Press.

Dakun, W. (2000). Vocabulary acquisition: implicit learning and explicit teaching. *REACT, 2,* 15-22.

Fainman, I., & Tokar, Y. (2018). Komponenty navchannia anhliiskoyi leksiki v aviatsiinomu VNZ [Components of teaching English vocabulary in aviation universities and colleges]. *Filolohichni Studiyi. Naukovyi Visnyk Kryvorizkoho Derzhavnoho Pedahohichnoho Universytetu [Philological Sudios. Scientific Collection of Krivoi Roh State Pedagogical University], 17,* 260-271.

Graves, M.F., August, D., & Mancilla-Martinez, J. (2013). *Teaching vocabulary to English language learners.* New York, USA: Teachers College Press.

Hirsch, E.D. (2003). Reading comprehension requires knowledge — of words and the world scientific insights into the fourth-grade slump and the nation's stagnant comprehension scores. *American Educator, 27,* 10-29.

Hirvela, A. R. (*2013*). *ESP and reading*. In B. Paltridge & S. Starfield (Eds.), *The handbook for English for specific purposes* (pp. 77-94). Chichester: Wiley-Blackwell.

Huckin, T., & Coady, J. (1999). Incidental vocabulary acquisition in a second language: a review. *Studies in Second Language Acquisition, 21,* 181-193.

Hulstijn, J.H. (2001). Intentional and incidental second-language vocabulary learning: A reappraisal of elaboration, rehearsal and automaticity. In P. Robinson (Ed.), *Cognition and Second Language Instruction* (pp. 258-286). Cambridge: Cambridge University Press.

International Civil Aviation Organization [ICAO] (2010). *Manual on the implementaion of ICAO language proficiency requirements*. Doc 9835 AN 453, 2nd ed. Montreal, Canada. Retrieved from https://www4.icao.int/aelts/ uploads/icao%20doc9835%202nd%20edition.pdf

Laufer, B. (2009). Second language vocabulary acquisition from language input and from form focused activities. *Language Teaching*, *42*, 341-354. doi:10.1017/S0261444809005771

McCarthy, M. (1990). *Vocabulary*. Oxford: Oxford University Press.

Kolosov, V. A., & Ivanova, T.A. (2000). Analiz oshibok rechevoho vzaimodeistviia ekipazhey i dispetcherov UVD [Analysis of mistakes in speech communication between crew and air traffic controllers]. In *Psihophiziolohicheskiie problemy povysheniia rabotosposobnosti liotnoho i dispetcherskoho sostava hrazhdanskoy aviatsii (Psychological and physiological problems of improving efficiency of civil aviation crew and ATCs)* (pp. 90-101). Saint Petersburg: Civil Aviation Academy.

Kusumawati, E., & Widiati, U. (2017). The effects of vocabulary instructions on students' reading comprehension across cognitive styles in ESP. *Journal of Education and Practice*, *8(2),* 175-184.

Mukoroli, J. (2011). Effective vocabulary teaching strategies for the English for academic purposes ESL classroom. *MA TESOL Collectio*n, 501, 1 -53.

Nagy, W. (1997). On the role of context in first- and second-language vocabulary learning. In N. Schmitt & M. McCarthy (Eds.), *Vocabulary: description, acquisition and pedagogy* (pp. 64-83). Cambridge, UK: Cambridge University Press.

Nation, I.S.P. (2001). *Learning vocabulary in another language*. Cambridge: Cambridge University Press.

Nation, I.S.P., & Webb, S. (2011). Content-based instruction and vocabulary learning. In E. Hinkel. *Handbook of research in second language teaching and learning, Volume II.* (pp. 631-644). London: Routledge.

Newton, J. (1995). Task-based interaction and incidental vocabulary learning: a case study. *Second Language Research, 11(2),* 159-177.

Ozola, I. (2015). Using audio materials for ESP vocabulary acqusition. In N. Stojkovič (Ed.), *Vistas of English for specific purposes* (pp. 317-324). Newcastle upon Tyne: Cambridge Scholars Publishing.

Petty, W., Herold, C., & Stoll, E. (1968). *The State of the knowledge of the teaching of vocabulary (Cooperative Research Project No. 3128).* Champaign, IL: National Council of Teachers of English.

Secer, Y. E., & Sahin, M. (2014). Challenges of teaching aviation vocabulary and radio phraseology at high school level. *International Journal on New Trends in Education and Their Implications, 5 (4),* 110-120.

Schmitt, N. (2000). *Vocabulary in language teaching*. Cambridge: Cambridge University Press.

Schmitt, N. (2008). Instructed second language vocabulary learning. *Language Teaching Research. 12(3),* 329–363.

Sökmen, A.J. (1997). Current trends in teaching second language vocabulary. In N. Schmitt, & M. McCarthy (Eds.), *Vocabulary: description, acquisition and pedagogy* (pp. 237-257). Cambridge, UK: Cambridge University Press.

Souleyman, H. M. (2009). Implicit and explicit vocabulary acquisition with a computer-assisted hypertext reading task: comprehension and retention. (Unpublished doctoral dissertation). University of Arizona, Tucson, Arizona, USA.

Stahl, S.A. (2005). Four problems with teaching word meanings (and what to do to make vocabulary an integral part of instruction). In E. H. Hiebert, & M.L. Kamil (Eds.), *Teaching and learning vocabulary: bringing research to practice* (pp. 95-114). Mahwah, NJ: Erlbaum.

Sternberg, R.J. (1987). Most vocabulary is learned from context. In M.G. McKeown, & M. Curtis (Eds.), *The nature of vocabulary acquisition* (pp. 89-105). Hillsdale, N.J.: Erlbaum.

Strevens, P. (1988). ESP after twenty years: A re-appraisal in Tickoo M. *ESP: State of the art* (pp.1-13). Singapore: SEAMEO Regional Centre.

Takač, V. P. (2008). *Vocabulary learning strategies and foreign language acquisition*. Clevedon: Multilingual Matters.

Tokar, Y., & Fainman, I. (2018). Teaching vocabulary in aviation English course: a step-by-step method, strategies and classroom activities. *Journal of Teaching English for Specific and Academic Purposes, 6(3),* 441-454.

Woodward-Kron, R. (2008). More than just jargon – the nature and roles of specialist knowledge in learning disciplinary knowledge . *Journal of English for Academic Purposes, 7*, 234–249.

Wray, A. (2002). *Formulaic language and the lexicon.* Cambridge: Cambridge University Press.

Zhang, W. (2008). *In Search of English as a foreign language (EFL) teachers' knowledge of vocabulary instruction.* (Unpublished doctoral dissertation). Georgia State University, Georgia, USA.

Zimmerman, C. B. (1997). *Historical trends in second language vocabulary instruction*. New York: Cambridge University Press.

Appendix A

Aviation English Course
Vocabulary Quiz 3B

Name: _____

Group: _____

Fuel.

1 Match a verb on the left with a definition on the right. 2 definitions are not used.

1. Emit _ 2. Leak _ 3. Suck _ 4. Strap _ 5. Corrode _	a) to fasten something in position by fastening a narrow piece of leather or other strong material around it. b) to move somewhere quickly and suddenly. c) to send out a beam, noise, smell, or gas. d) be slowly damaged by something such as rain or water. e) to remove ice. f) (of a liquid or gas) to escape from a hole or crack in a pipe or container**.** g) remove smth using the force of air.

/5

2 Rearrange the letters to form the missing words.

Most recently built planes have two fuel **(1) nstka _____** or cells which are located in the wings. The fuel **(2) tacpaiyc** _____ for each aircraft is determined by its wing geometry. In a lot of aircraft, (3) **smpup** _____ are required to feed the fuel through (4) **soshe**_____ from the cells to the engine. For every fuel cell there is a fuel (5) **eagug** _____ that the pilot can read from the cockpit in order to keep an eye on the fuel (6) **esprruse** _____. The continuous movement of fuel is called fuel (7) **oflw** _____ and the fuel (8) **scnoupitmon** _____ is a measure of the fuel used by the engine. If the movement of the fuel is somehow slowed down, or if there is a (9) **ethasgor** ____ of fuel, this can cause fuel (10) **vistanrato** _____, which in turn can cause loss of power in the engine.

/20

3 Complete the sentences with the correct form of the words in capitals

0 The police have been very **<u>ineffective</u>** in cutting car crime in our town. **EFFECT**

1 The European Commission has suggested limiting CO2 _____ for all planes departing from EU airports. **EMIT**

2 A controller will always ask the pilot to state the aircraft's fuel _____ **.** **ENDURE**

3 Initial reports indicate problems with fuel system. It seems that the cockpit instruments were _____. **OPERATE**

4 We had no indication of a fuel _____. **SHORT**

/4

4 Make words that match the definitions by adding the prefixes in one box to the words in the other box. Some prefixes can be used twice while the others can be not used at all.

re-	**de-**	**ab-**	**in-**	**un-**	**dis-**	**out-**	**over-**	**mis-**	**under-**
ice	**estimate**	**operative**	**accurate**		**weight**	**fuel**	**diagnose**		
	normal		**sufficient**		**compression**				

1 to remove ice _____
2 not working _____
3 not enough _____
4 to put more fuel into an aircraft _____
5 a reduction in pressure around something _____
6 not usual _____
7 heavier than it is allowed _____
8 to state that a device has a particular condition, when in fact it has a different one _____
9 not completely correct or exact _____
10 to fail to guess or understand the real cost, size, difficulty, etc. of something _____

/20

5 Use the words from task 4 and fill in the gaps. Change the form of the verbs if necessary.

1 They (1)_____ the problem as fuel freezing, when in fact there was no fuel left in the tank.
2 I think the altimeter is giving (2) _____ readings – we are clearly higher than 500 ft.
3 The aircraft is (3)_____ for landing, so we'll have to dump fuel.
4 They (4)_____ the amount of fuel needed for the journey, so the aircraft had to divert to (5)_____.

/10

6 Read the definitions and write the terms for them.

1 a weakness that develops in metal structures that are used repeatedly _____
2 to bend something or become bent, often as a result of force, heat, or weakness _____
3 a serious decrease or exhaust of the abundance or supply of smth _____
4 a device that opens and closes to control the flow of liquids or gases _____
5 a reduction in the amount or degree of noise _____
6 an aircraft's ability to keep flying; how long the aircraft can fly _____
7 a small hole made by a sharp object, especially in a tyre _____
8 to (cause something to) explode, break, or tear _____

/16

7 Choose the correct words to complete the sentences.

1 They began descending but the fuel ***starvation/ flow/ endurance*** stopped completely.
2 The aircraft had serious ***corrosion/ emission/ abatement*** due to operating in a salty environment.
3 After the fuel ***valves/ hoses/ gauges*** are removed the fuel load is checked.
4 They lost both engines due to fuel ***capacity/ starvation/ shortage***.

5 The European Federation for Transport and Environment disagrees with the conclusion and describe the information as ***operative/inaccurate/ overweight***.
6 Attention turned to how an aircraft had run out of fuel. It emerged that a serious fuel ***leak/ pump/deice*** had developed in one of the aircraft's two engines.
7 Climate change mitigation policies for aviation may ***diagnose/ overestimate/ rupture*** the benefit of alternative fuel use on the global climate system.
8 The structure of the aircraft has been designed to ***refuel/ endure/ buckle*** for decades thanks to its metal structure.
9 Emissions from aircraft engines change the chemistry of the atmosphere and can modify the global climate and cause ***depletion/ decompression/ deice*** of the ozone layer.

/9

8 Complete the sentences by adding one word in each space

1 They decided to open cross-feed _____ to divert fuel from the wing tank which was functioning properly to the engine with the leak.
2. Concerns over aircraft noise led to noise _____ procedures to minimize noise for people living near the airport.
3 The first question a pilot needs to ask is what should be the normal fuel _____ assuming all goes according to plan en route.
4 Air transport contributes 2% of global CO2 _____.
5 When you say *puncture* you mean a large hole in the cabin causing explosive _____.
6 If the design of the aircraft is such that gravity cannot be used to transfer fuel, fuel _____ are installed.
7 Turbine engines burn fuel faster than reciprocating engines do. Because fuel needs to be injected in to a combustor, the injection system of a turbine aircraft must provide fuel at higher _____ and flow compared to that for a piston engine aircraft.
8 Special fluid, a mixture of a chemical called glycol and water, is generally heated and sprayed under pressure to _____ the aircraft.

/16

TOTAL /100

Appendix B

Theme: Fuel

Word list

1 emit – emission
2 leak
3 suck out
4 strap
5 corrode – corrosion
6 fuel tank
7 fuel capacity
8 pump
9 hose
10 gauge
11 fuel pressure
12 fuel flow
13 fuel consumption
14 fuel starvation
15 fuel shortage
16 deice
17 (in)operative
18 (in)sufficient
19 (over/under)estimate
20 (mis)diagnose
21 (in)accurate
22 overweight
23 refuel
24 abnormal
25 decompression
26 endure - endurance
27 metal fatigue
28 rupture
29 buckle
30 depletion
31 valve
32 noise abatement
33 puncture

Collegiate Aviation Review International

Volume 37 | Issue 2 Literature Review #1

9-7-2019

The Intersection of Race, Gender, and Socio-Economic Status in the Life of Bessie Coleman

Paul E. Cline
City University of New York

Gender is everywhere and influences everything. Gender can often be a system of social control. It is the primary way society groups its inhabitants. That said, gender does not act in isolation. Rather, it is part of a larger network of control that includes such elements as race, color, creed, religion, sexuality, gender identity, national origin, and socio-economic status. These factors are clearly evident in the life of Bessie Coleman, the first African American pilot of either sex to earn an international pilot's license. Born into poverty in the waning years of the nineteenth century, Bessie Coleman had four distinct disadvantages: she was poor, female, and African American and Native American in the post reconstruction South. Bessie Coleman's story is both encouraging and heart wrenching. She was a woman far ahead of her time in a society not yet ready to accept a woman of color succeeding in what until then had been the private domain of white males.

Recommended Citation:

Cline, P.E. (2019). The Intersection of Race, Gender, and Socio-Economic Status in the Life of Bessie Coleman. *Collegiate Aviation Review International*, 37(2), 133-156. http://dx.doi.org/10.22488/okstate.19.100219

Gender is everywhere and influences everything. Gender can often be a system of social control. It is the primary way society groups its inhabitants. That said, gender does not act in isolation. Rather, it is part of a larger network of control that includes such elements as race, color, creed, religion, sexuality, gender identity, national origin and socio-economic status.

Each of these areas act synergistically with the others to enforce and perpetuate the status quo. As part of a system of systems, gender helps to reinforce the established social norms and ideals that shape the behavior of people, generate hierarchy, and oftentimes results in economic and non-economic inequalities among ascriptive groups (Arestis, Charles, & Fontana, 2014).

The interplay of these various foci of control are evident in the life of Elizabeth "Bessie" Coleman. Born into poverty in the waning years of the nineteenth century, Bessie Coleman had four distinct disadvantages: she was poor, female, and African American and Native American in the post reconstruction South.

Born in Atlanta Texas on January 26, 1892. Bessie Coleman was "born in a one room cabin, raised in a single-parent family, and educated in a school for black children that closed whenever the cotton needed picking" (Rich, 1993, p. 2). Her mother, Susan Coleman was a tall, thin woman who gave birth to thirteen children over the space of twenty-three years, four of whom did not survive childhood. Her father, George Coleman, was 75% Native American and 25% African American. His family came from "Indian Country," before settling in Texas. Bessie's birth was not commemorated either with a birth certificate or in the family bible, since both Susan and George Coleman were illiterate; neither could read or write (Rich, 1993). According to Rich (1993):

> The world Bessie entered was one of not only grinding poverty and incessant labor but repressed rage and fear. Two years before her birth the state of Mississippi had begun the process of disenfranchising African Americans by legal means, a process soon followed by all of the Southern states. Three months after Bessie's birth a black postal employee in Memphis, Tennessee, and his two partners who had financed a small grocery store were taken by a mob from a Memphis jail and killed a mile outside the city. Their offense was to defend their property from an armed attack by white night raiders. (p. 4)

Despite the racial and economic repression, George Coleman managed to save enough money from his job as a day laborer to acquire a small plot of land in Waxahachie, Texas, a small hamlet 30 miles south of Dallas (Hardesty, 2008; Rich, 1993). In the segregated South, Waxahachie was divided by the railroad—whites to the west and people of color to the east. It was in this eastern section that George Coleman bought one quarter of an acre for $25.

Bessie started school when she was six years old in the segregated, one room schoolhouse on the east side of Waxahachie. The school was "hot in the summer and cold in the winter" and staffed by one teacher for grades one through eight. A Columbia University study from 1922 showed that many rural schools were staffed by instructors with no more than a sixth-grade education (Rich, 1993, p. 7). The Waxahachie school was no exception. Bessie walked four miles each way to class and quickly established herself as a star pupil in math.

George Coleman left the family in 1901. He had, he told Susan, "enough of Texas." Jim Crow laws (enforced segregation of public accommodations by race) prohibited him from riding in the same rail car as whites, voting, or having any say in local government. His status as a day laborer denied him

access to more stable employment in either the textile mills or railroads, both of which were booming at the time. In a strange twist of fate, George's Native American ancestry placed him in greater jeopardy than his African American lineage. Native Americans in Texas during the late nineteenth and early twentieth centuries were considered "savage and treacherous" and violence against Native Americans was common and unprosecuted. George wanted to move to Oklahoma, where he said he could enjoy the full rights of citizenship. Susan told him he could go if he wanted, but she was neither "pioneer nor squaw" (Rich, 1993, p. 8).

George's leaving left Susan with four young daughters to raise, the oldest Bessie at nine. To support the children, she began working as a cook and domestic servant to a white couple, Mr. and Mrs. Elwin Jones. This placement proved a Godsend for Susan and her daughters. Mrs. Jones provided most of the food Susan and the girls ate during this time. Additionally, the young girl's dresses were often hand-me-downs from Mrs. Jones' own daughters, and far nicer than anything Susan could afford or sew (Rich, 1993, p. 9).

Women of color rarely fared so well under codified segregation. "Violence is the mortar that lies between the brick and stone constructing this space. Violence is a daily reality that seems to exist just about everywhere. For a woman living within the confines of Jim Crow, violence resides in and outside of home: the bed where she sleeps, the space in which she strolls, the environment where she works, and even the places where she goes for recreation" (Norwood, 2018, p. 97).

The systematic use of rape as a form of control under conditions of chattel slavery has never been seriously contested. The use of black women for sexual gratification and as a means to humiliate and emasculate the male slave population has been adequately chronicled by historians and social scientists alike (Roberts, 1998). What is less well known is the continued abuse that occurred under Jim Crow from Reconstruction until the latter half of the twentieth century.

There was little to deter white men from committing racist sexual violence. Rape against a woman of color was not considered a crime in many jurisdictions, and if it was, it was rarely prosecuted, as African Americans were restricted from testifying against white men in court (Thompson-Miller & Picca, 2017, p. 936). The fear of retaliation and losing their sole source of income induced many domestic workers to leave assaults unreported, and deal with the physical and psychological trauma in any way possible. While there is no evidence that either Susan or Bessie suffered directly, sexual violence and degradation were so pervasive it would have been an unavoidable stressor for both women; especially as they traveled to the west side of Waxahachie.

While Susan was at work, Bessie took over the running of the Coleman household. Cooking, cleaning, mending clothes and watching her siblings was Bessie's new reality. These activities were carried out without the luxury of electricity or running water. "Water was drawn from an outdoor well. Laundry was done in an iron tub, and meals were prepared on a wood-burning stove that also heated the house" (Rich, 1993, p. 9). She often missed days and weeks of school in order to care for her younger siblings. When the children were old enough to attend school, they made the eight-mile round trip with their older sister. In Texas, like much of the South, cotton remained king. Because of this, the small one room schoolhouse was shuttered during harvest. This was a mutually beneficial arrangement. The wealthy landowners and farmers needed labor, and the Coleman's and their neighbors needed the money. Even Susan was excused from her duties at the Jones' to work in the fields.

Despite these roadblocks, Bessie completed all eight grades of Waxahachie's one room black school. Bessie knew her future did not lie in the dusty fields of Texas. With Susan's encouragement Bessie began working as a laundress in order to save for her escape.

Bessie worked from home, collecting and delivering her client's dirty laundry once a week. Each trip to the west side of Waxahachie was 5 miles each way. There was no public transportation and the Coleman's sole means of transportation was their feet. Bessie would boil the clothes in a tub in her back yard, scrub it on a washboard, rinse, starch, wring it out, and hang it on a clothesline to dry. She ironed with a heavy metal instrument heated on the top of the wood fired stove. On Saturday Bessie would deliver the laundry, "keeping her place" by bringing it to the back doors of the west-side residents (Rich, 1993, p. 13).

In 1910 Bessie left Waxahachie for Langston, Oklahoma to enroll in the "Colored Agricultural and Normal University." Langston, one of several all black municipalities in Oklahoma, was named after John Mercer Langston, an uncle to the poet Langston Hughes' mother.

To describe the Langston school as a university would be a stretch. A land-grant institution, it was much more a vocational school or small college than a full-fledged university. Offering four-year degrees in education, agriculture, home economics and mechanical arts, it also included a preparatory school for new students who lacked the requisite qualifications to be admitted as a normal student. It was to this category that Bessie was admitted, being placed (at the age of 18) in the sixth grade.

Despite adequate academic performance, Bessie ran out of money after one term and was forced to return to Waxahachie and other people's laundry. Five years later, in 1915, Bessie's older brother Walter suggested she move to Chicago and stay with him (Hardesty, 2008). The train trip between Waxahachie and Chicago took twenty hours and was another example of the pervasive inequality and racism at the time.

> The car on which Bessie sat on a hard wooden bench exemplified the oppression she longed to escape, a world of rear seats on buses and balcony seats in theatres, of forbidden public restaurants, water fountains, and lavatories, a world in which the old taboos and fears were now being augmented by a new one, the resurrection of the Ku Klux Klan, first in the South and soon after throughout the nation (Rich, 1993, p. 16).

Bessie Coleman was not alone. Between 1915-1920, a period known as the "Great Migration," "10% of the black population fled the South" (DeSantis, 1998, p. 475). The reasons for this mass exodus are varied, and there is no clear consensus among historians as to the primary cause. Many believe the main driving force behind the Great Migration was economic. Known as the *Push-Pull theory*, it posits that African Americans were pushed out of the South by the grinding poverty, social inequity, and lack of hope for any meaningful change. Conversely, these migrants were pulled towards the north by the promise of employment, fair pay, civil rights and the chance for a better future.

A second theory, the *Socio-Emotional or Sentimental theory* emphasizes the social motivations for abandoning the South. In addition to the intolerable inequality, there is also a familial dimension to the exodus: a desire to join friends and family who had previously migrated and were now established in cities such as New York and Chicago. Elements of each theory can be seen in Bessie Coleman's exodus. She was anxious to leave behind the dehumanizing reality of life under Jim Crow, excited to be reunited with her older brother and his new family and was looking forward to making her own way economically in a place where race was not the sole determining factor.

It would be wrong to suggest that Chicago in 1915 was a nirvana void of racial tension and animosity—it was not. The main difference between Chicago and Waxahachie was that racism was not institutionalized and codified like under Jim Crow. For all that, it was no less insidious. Rather, "shunned by all other groups, blacks erected their own enclave. Pride, habit, and the need for mutual

protection led to the establishment of a self-segregated ghetto with its own churches, clubs, and fraternal organizations" (Rich, 1993, p. 16).

Nowhere in America at this time were African Americans viewed as equal. This is readily apparent by one of the highest grossing movies of entire twentieth century, D.W. Griffith's *The Birth of a Nation.* Described as "the most controversial motion picture of all time" (Knight, 2010, p. 78), Griffith's three-hour marathon glorified the Ku Klux Klan in their fight to maintain racial and cultural purity in the face of repeated assaults by African Americans, foreign born immigrants, Catholics, and Jews. The cultural panic Griffith tapped into was very real, even in the North. The film "expressed the defensive reaction of white Protestants in small-town America who felt threatened by the Bolshevik revolution in Russia and by the large-scale immigration of the previous decades that had changed the ethnic character of American society" ("Ku Klux Klan," n.d.).

The Birth of a Nation was America's first full length feature film. Consisting of over 13,000 individual shots and occupying 12 reels of film, it was an immediate sensation, with over 200 million viewers between 1915 and 1946 (Finler, 2003, p. 47). A *Variety Magazine* poll of 200 film critics voted *The Birth of a Nation* the greatest motion picture in the first 50 years of the industry (Rogin, 1985, p. 150). After a private screening in the White House, Woodrow Wilson declared, "It is like writing history with lightning! And my only regret is that it is so terribly true" (Pitcher, 1999, p. 50).

This one film is credited with reinvigorating the modern Ku Klux Klan. Its influence can be seen today, over a century after its release. The iconic white robes and peaked hats worn by modern Klansmen are not historical; they are an invention of D.W. Griffith's cinematic fantasy (Rice, 2016, p. 2).

It is hard to overstate the influence of the Klan during this time. On August 8, 1925, over 30,000 robed Klansmen marched 22-abreast down Pennsylvania Ave in Washington, DC. The next morning, the Washington Post's front-page headline declared, "White-robed Klan cheered on march in nation's capital." The main story went on to describe how the "Phantom-like hosts of the Ku Klux Klan spread their white robe over the most historic thoroughfare yesterday in one of the greatest demonstrations this city has ever known" ("White-robed Klan cheered on march in nation's capital," 1925).

It was into this environment that Bessie Coleman arrived. She was "leaving the segregation of the South for the ghetto of the North" (Rich, 1993, p. 17). Walter Coleman was the first of the Coleman children to leave home and had been living in Chicago for the last decade. The Coleman household was crowded. In addition to Walter and his wife Willie, another Coleman brother, John and his wife Elizabeth were already living there when Bessie arrived.

Walter's wife Willie was a domineering woman accustomed to getting her own way. This caused no small degree of strife within the Coleman household. Bessie clashed frequently with Willie, who she considered "too bossy." Willie had cowered everyone in the household, everyone except Bessie (Rich, 1993, p. 18).

From the moment of her arrival in Chicago, Bessie began looking for work. As in the South, most African American women working outside the home did so as domestics. This was not part of Bessie's plans. She had not left Texas to do other people's laundry in her new home.

Soon after arriving in Chicago, Bessie enrolled in the Burnham School of Beauty Culture for a course in manicuring. This was a shrewd decision. The manicurist course was short and did not require the extensive preparation needed for a beautician, even though she would frequently function as one. She was successful. In 1916 Bessie won a contest to decide who was the best manicurist in black Chicago.

Bessie Coleman was a gifted self-promoter. She initially plied her trade not in beauty shops catering to well-heeled African American women, but in the barber shops that lined State Street, an area Chicago historian Dempsey Travis described as a "black Wall Street and Broadway" (Travis, 2014, p. 30). Working at a table sat in the window, Bessie's customers could be seen having their nails done by a "very pretty woman." "As a manicurist she could do men's nails in a barbershop, where the customers appreciated her looks and charm and expressed their admiration in generous tips" (Rich, 1993, p. 20).

Much like the African American church, African American owned barber shops and beauty parlors were an integral part of life during the Great Migration. "Jim Crow ordinances forced places such as churches, bars, social clubs, barber shops, beauty salons, even alleys to remain 'black' space" (Gill, 2010, p. 3). These places gave African Americans a space undeniably their own and they were treasured and protected. When the migrants moved to the North, they took these quasi-social institutions with them.

During his travels later in life, Booker T. Washington noted with pride how just one generation removed from the shackles of enslavement, and fighting for their ever-diminishing citizenship rights, African American men and women were embracing entrepreneurship. These small businesses offered the hope of lifting African American citizens out of the grinding poverty and servitude that had characterized their existence since arriving involuntarily on the shores of the New World (Gill, 2010).

According to Gill (2010), this "golden age" of African American business, saw

> …unprecedented growth of black business enterprises and the celebration of entrepreneurship as a promising venue for middle-class blacks to rise above the economic ravages of segregation ... business and economic empowerment was viewed by black leaders of the day to be one of the more effective challenges to white supremacy and the ravages of second class citizenship" (p. 8).

This "racial uplift" ethos was primarily a masculine undertaking. At an 1899 conference hosted by W. B. Du Bois, women's voices were decidedly muted. Although three women addressed the conference, they all discussed the need for "black men to help the race as well as himself by owning a business enterprise … none of them discussed the role of women in the black business community" (Gill, 2010, p. 12).

African American women were acutely aware of the need for economic independence and sought to make it a central tenet of the racial uplift movement. Alberta Moore Smith, one of the founding members of the Colored Woman's Business Club of Chicago argued that "the strength of many young women was being wasted by laborious work in sweat-shops, factories and stores" (Gill, 2010, p. 16). In her mind, these women would be better served working for themselves, rather than those with no interest in improving conditions for African American women.

For African American women during the first part of the twentieth century, entrepreneurship was a way to preserve one's dignity while moving from abject poverty to working-class status. "African American women have worked outside of their homes for centuries" (Wade, 2010, p. 483), what separated them from their white feminist counterparts, is this labor was not an option or a freedom to be gained. Work outside the home was a prerequisite to the family's survival.

In Bessie's case, the visibility offered by her job, and the status she received, played a key role in making the future events of her life possible. By working on the most prominent thoroughfare in black Chicago, Bessie saw, and was seen by the movers and shakers of Chicago's African American community.

The acquaintance that would have the greatest impact on her career was Robert S. Abbott, publisher of the *Chicago Defender*. "Spokesman for the race and owner of a newspaper whose readers would soon number a half million, Robert Abbott was a handsome, elegantly dressed, still youthful man in his mid-forties." He would stand on the street corner and "hold court" with community leaders. "Abbott told them what they ought to do and they often did it" (Rich, 1993, p. 21). Although there is no indication of any romantic involvement between Abbott and Bessie, she clearly idolized both his persona and political power.

The *Chicago Defender* was one of the most influential African American newspaper during the early and mid-20th century. It had a national editorial perspective and played a leading role in the great migration of African Americans from the South to the North ("Chicago Defender," 2019). As publisher, Abbott was simultaneously cheered and vilified. Florette Henri, a historian and writer who studied discrimination against African Americans and American Indians, said that if "there was finally a black Joshua it was Robert Abbott" (Henri, 1975, p. 63). Sociologist Gunnar Myrdal described Abbott as "the greatest single power in the Negro race" (Desantis, 1997, p. 63).

Abbott's detractors took a decidedly different view. Black-nationalist leader Marcus Garvey accused Abbott of being a "race defamer" that "publishes in his newspaper week after week the grossest scandals against the race" (Desantis, 1997, p. 63). Julius Rosenwald, the multi-millionaire business tycoon and philanthropist whose Rosenwald Fund donated millions of dollars to help educate African American children in the rural south, thought Abbott a "monkey with a shotgun" (Desantis, 1997, p. 63).

Love him or hate him, there was no denying Abbott's power to influence millions of readers. A lawyer by training, Abbott was told he was a "little too dark to make any impression on the courts of Chicago" (Desantis, 1997, p. 64). Tired of the racism and eager to be economically self-sufficient, Abbott decided to start his own paper. This was no easy task given there were already three African American papers in circulation.

The first issue of the *Chicago Defender* went to press on May 5, 1905 (Desantis, 1997, p. 65). The early years of the *Defender* were markedly different in style and content than those published during the paper's heyday. These early offerings were concerned with local gossip and special interest stories. There was no mention of the racial injustice, segregation, or white-on-black crime that characterized Abbott's later journalism. That was to change in 1910-1911.

> His inaugural expose dealt with the white-supported red-light district on Chicago's black South Side. Abbott became outraged by the blatant disregard white governmental officials showed for his community. A thousand black readers a week began snatching up copies of the Defender to read Abbott's editorials about the sins of sex, drinking, and the white governmental officials who promoted such behavior. While the issue itself is historically insignificant, the ramification of the story for the development of the Defender cannot be underestimated: Abbott learned that if he could get his readers involved in a fight, "especially if underscored by a racially high-minded purpose," he would not only uplift his race, but achieve wealth and success as well. (Desantis, 1997, p. 66)

It was Abbott's eye for the sensational, and his never-ending quest to advance the position of African Americans in U.S. society, that set him on a collision course with Bessie Coleman. With no diaries to enlighten later generations, it is not known for certain how or why Bessie became interested in flying. What is known is that during World War I Bessie had read the exploits of the early military aviators, and that her brothers, soldiers during the Great War, had regaled her with stories of French female aviators.

Whatever the motivation, Bessie Coleman had decided aviation was her vocation and she was not going to take no for an answer. Her early attempts at finding an instructor were failures. No one would train an African American woman to fly. As one white flight instructor put it, "there was no room for black birds in the sky over America" (Creasman, 1997, p. 158).

Bessie shared her hopes and frustrations with Robert Abbott; gaining not only an ally, but a source of funding. Abbott realized the potential economic and political bonanza an African American female aviator could produce. It was Abbott who insisted that Bessie go to France to learn to fly. He instructed her to learn French and save her money. When it became time to go, he would find a way to help finance her travel.

To many in the African American community, France was the new Jerusalem; a country known not for segregation, but acceptance. France became a fixture in the African American consciousness following World War I. The war occasioned "the largest transatlantic movement of black men since the days of the middle passage (200,000 African Americans would serve in France during and after the Great War)" (Whalan, 2005, p. 776). This resulted in large numbers of soldiers returning to the United States having enjoyed a level of acceptance heretofore never imagined. The impact of these experiences cannot be underestimated.

> In his account of inspecting African American troops in Europe following the armistice, W. E. B. Du Bois remarked that "there is not a black soldier but who is glad he went, — glad to fight for France, the only real white Democracy; glad to have a new, clear vision of the real, inner spirit of American prejudice." Similarly, in his welcome address to returning African American soldiers in Washington in April 1919, the Reverend F.J. Grimké told the troops that in France they had had "the opportunity of coming into contact with another than the American type of white man; and through that contact you have learned what it is to be treated as a man, regardless of the color of your skin or race identity. Unfortunately, you had to go away from home to receive a man's treatment, to breathe the pure, bracing air of liberty, equality, fraternity." (Whalan, 2005, p. 778)

The experiences of returning African Americans soldiers affected not only the African American community, but white America as well. In his influential work, "The Ethics of Living Jim Crow," Richard Wright (1991) lists several subjects that were taboo for discussion between African American and white men. Paramount among them were "American white women; the Ku Klux Klan; France, and how Negro soldiers fared while there …" (p. 15).

In addition to Abbott, the notorious Jesse Binga became Bessie's main financier. Binga was known as a "block-buster" real estate dealer. He would buy properties in white neighborhoods and sell them to African American clients. When the white neighbors began to flee, he would buy their properties at rock bottom prices and re-sell them for sizeable profit. Binga was "unloved, but respected and even feared" (Rich, 1993, p. 31) in Chicago's African American community. While there were rumors that Bessie was Binga's mistress, there is no proof of this.

Little is known about Bessie's personal life at the time. Extremely independent, she flaunted social convention and was often seen in the company of different men, unchaperoned. Her niece Marion Coleman recalled that "she had a lot of men callers, some were black and others were white – and several nationalities. I remember hearing different languages." While there is no evidence that any money exchanged hands, or that these gentlemen friends received sexual favors in return for their support, rumors of this type dogged her until her death (Rich, 1993, p. 31).

It is worth noting the moral strictures in place at the time. Racial boundaries are also sexual boundaries. As such they are "heavily patrolled, policed, and protected" (Nagel, 2000, p. 107). When race and sex collide, you get a strange, often contradictory and hypocritical set of social controls. "Our women (often depicted as virgins, mothers, pure) v. their women (sluts, whores, soiled). Our men (virile, strong, brave) v. their men (degenerate, weak, cowardly). These heteronormative ethno-sexual stereotypes are nearly universal depictions of self and other as one gazes inside and across virtually any ethnic [racial] boundary" (Nagel, 2000, p. 113).

The prohibition against inter-racial sexual relations was, at least officially, iron clad. That is not to say inter-racial sexual relationships were not common. To a large extent, whether a relationship was accepted depended upon its makeup. White men had been involved with African American women since the earliest days of the African slave trade. Since the legal status of the child followed the mother, the offspring of such relationships did not threaten the prevailing social order. A child of a slave was born a slave (Hodes, 1993, p. 402). This remained painfully true long after the end of the Civil War, especially under Jim Crow.

A sexual relationship between an African American man and a white woman was universally forbidden, and if discovered often had disastrous, if not lethal consequences. This relationship has been treated as taboo since the early days of chattel slavery and signified the greatest fears and insecurities of a white population outnumbered by their slaves. Maintaining this prohibition was essential to maintaining order.

> Intimate, heterosexual relationships between white women and black men have historically been considered a challenge to the gender and class-based racial privilege of white men, who were allowed to engage in intimate sexual relationships with "other" women with relative impunity. The gendered and racialized privilege of sexual agency belonged only to white men for centuries. In every colonial society, the only socially accepted ethno-sexual adventurers were privileged white males, since they wielded the economic, militaristic, and discursive power in society. (Meszaros & Bazzaroni, 2014, p. 1260)

In the years immediately following the Civil War, and well into the 20th Century, the most common excuse given for lynching African American men was the accusation that the man had sexual intentions towards a white woman. These accusations triggered "the cult of southern honor, the need to reaffirm traditional hierarchical power relationships, and white-black psychosexual tensions channeled into ritualized killings that helped preserve the economic and social preeminence of southern white males" (Finnegan, 2014, p. 850). A white man raping a black woman was not illegal in many states. A black man talking to a white woman unbidden could result in the man's very public and gruesome death.

Additionally, a woman of any race being single into her middle and late twenties was also very unusual. For Bessie to be single, and seen in the company of different men, invariably invited the type of malicious gossip she was routinely subjected to. Given the hypersexualized and fetishized image of African American sexuality so prevalent at the time (Blair, 2014, pp. 4–10), it was beyond the imagination of contemporary society that a man may be willing to assist an African American woman achieve her goals, for whatever reason, without the exchange of sexual favors in return.

On November 4, 1920 Bessie applied for a passport at the Chicago office. For reasons unknown, she gave her birthdate as January 20, 1896, four years after her real date. Her brother John acted as a character witness and swore his sister was an American citizen born on that date. The passport was issued on November 9th. After securing a month's transit permit from the British and a French tourist visa valid for one year, Bessie left for the continent on November 20, 1920, sailing from New York City aboard the S.S. Imparator (Rich, 1993, p. 32).

Once in France, her initial attempt to secure flight lessons was rebuffed. The school had experienced two deaths of female student pilots and refused to train any more women pilots. She was finally accepted at what was at the time, one of the premier flight schools in France, Ecole d' Aviation des Freres (The Caudron Brothers Aviation School) in le Crotoy in the Somme region of northern France. Operated by Rene and Gaston Caudron, Bessie remembered the curriculum as being "strict and unforgiving" (Hardesty, 2008, p. 8). During her seven months with the Caudron brothers she learned rudimentary piloting and navigation skills as well as acrobatic maneuvers such as "tail spins, banking, and looping the loop" (Rich, 1993, p. 32).

In what sounds utterly preposterous to the modern ear, one of the early concerns with women flying was that their uterus would prolapse. Although more than likely the result of a moral panic caused by women's increasing independence, this concern was nonetheless couched in pseudo-scientific language and printed in reputable journals. In 1898 a Berlin doctor named Gerson claimed that "violent movements of the body can cause a shift in the position and a loosening of the uterus as well as prolapse and bleeding, with resulting sterility, thus defeating a woman's true purpose in life, i.e., the bringing forth of strong children" (Pfister, 1990, p. 191). This is simply biological determinism in action. As such, a woman is reduced to her reproductive functions and any activity outside of that is suspect and against the laws of nature. Reproduction is a woman's only "true purpose" in life.

That said, aviation can be extremely unforgiving, and accidents during this time were common. Flying aircraft made of wood and fabric, and with engines that were heavy, temperamental and prone to fire, pilots in the early part of the twentieth century rarely lived to die of natural causes. Bessie learned to fly in the French Nieuport Type 82 trainer, a twin seat, open cockpit biplane "known to frequently fail in the air" (Staurowsky, 2007). Based on the Nieuport 14 observation aircraft used by Allied forces in World War I, the Nieuport Type 82 had dual controls and was powered by an 80 horse power rotary engine and came equipped with "anti-turnover wheels" mounted ahead of the main landing gear designed to prevent the aircraft from nosing over on rough terrain or after imperfect landings (Sanger, 2002). While at the Caudron Brother's School she witnessed the death of another student, an event that "was a terrible shock to my nerves, but I never lost them; I kept going" (Rich, 1993, p. 32).

The Type 82 trainer was a primitive machine. The engine was started by a mechanic who first primed it with castor oil and then hand propped the engine to life. The noise, heat, and fine mist of oil blowing back into the pilot's face made communication difficult. Rudimentary tube intercom systems (a hollow tube with a funnel at either end that the instructor shouted directions into) were ineffective at best. Bessie learned to communicate with her instructor by feeling his movements on the yoke and rudder bar. She quickly learned to mimic these movements and thus learned to control the aircraft.

The instrument panel consisted only of a tachometer for the engine and a highly inaccurate altimeter. Attitude was assessed visually or by a metal nut attached to the end of a piece of string hanging from the windscreen. Since the dual controls were linked, if one of the two people controlling the aircraft "froze" at the controls and held them in place, it was possible both aviators could be killed.

Bessie Coleman earned her pilot certificate from the Federation Aeronautique Internationale (FAI), on June 15, 1921. The FAI was "the only organization at the time whose recognition granted one the right to fly anywhere in the world" (Rich, 1993, p. 34). It was founded by representatives from Belgium, France, Germany, Great Britain, Italy, Spain, Switzerland, and the United States, during meeting in Paris on Oct. 14, 1905. Chartered as a non-governmental, not for profit organization, its stated purpose is to promote and encourage private "sport" aviation and certify world records (Whittall, 2019). Of the 62 candidates to earn FAI licenses between January and June of 1921, Bessie Coleman was the only woman.

Bessie's return to the United States in September 1921 was far different from her departure ten months earlier. She was met dockside and interviewed by reporters who described her as "a full-fledged aviatrix, the first of her race" (Rich, 1993, p. 35). Upon her return to Chicago she gave an exclusive interview to the *Defender*, not surprising given her debt to Robert Abbott. In the interview Bessie reviewed every detail of her experience in Europe. When asked why she wanted to fly, she said

> We must have aviators if we are to keep up with the times. I shall never be satisfied until we have men in the Race who can fly. Do you know you have never lived until you have flown? Of course, it takes one with courage, nerve and ambition. But I am thrilled to know we have men who are physically fit; now what is needed is men who are not afraid of death (Rich, 1993, p. 36).

This exchange is confusing. Bessie Coleman was the first African American of either sex to earn a prestigious FAI license, yet she emphasizes the need for African American men to step up and accept the mantle of the race in this new endeavor. Was she simply being politically correct? It seems highly unlikely that she held the same misgivings her male colleagues had regarding female pilots. There is no clear answer to this question. Her own life was a direct affront to the social conventions of the time, yet when pressed, she gave a very traditional answer.

Despite her newfound notoriety, Bessie had no visible means of support. Most pilots at the time earned their living Barnstorming and performing in Flying Circuses. This was a miserable itinerant life. The term barnstorming originally referred to traveling theatre groups who set up, and often slept in barns as they performed for rural audiences throughout the south and Midwest. Following World War I, it came to signify pilots who would buzz a small community attracting attention, and then thrill the spectators with aerobatic maneuvers and take customers on their first ever plane rides, often charging "a penny a pound" (Kitchens, 2003).

In its heyday, "exhibition flying attracted huge crowds of ticket-buying customers. Stunt fliers rivaled vaudeville stars in their celebrity. Man's newfound ability to fly, the culmination of centuries of dreaming and ill-fated experimentation, commanded widespread enthusiasm and support among the public and the engineering minded in the scientific community" (Cameron, 1999, p. 8). It was also deadly. Pushing their fragile wood and cloth machines to the edge of the performance envelope, structural failure and crashes were common. Flyers at the time complained that the audience was not happy unless someone died (Hardesty, 2008).

Initially, most barnstormers performed either alone or in pairs. In time larger, better funded and more organized productions known as flying circuses began to appear. One of the best known was the "Gates Flying Circus." Ivan R. Gates began barnstorming in a homemade airplane in 1911. Over time he recruited several other fliers who performed in tandem. "Mr. Gates prospered, as did most fliers who were not killed or crippled … one of the ordinary tricks was jumping from one plane to another in the air. The Gates' wing-walkers were accustomed to climb down, hang from the under carriage and drop to the upper wing of another plane flying underneath" ("Gates, Stunt Flier, Ends Life By Leap: Founder of Flying Circus Jumps out Window as Wife Tries to Hold Him Back," 1932).

It was against this backdrop that Bessie contemplated joining the barnstorming circuit. Knowing she lacked the requisite aerobatic skills to compete in such a competitive marketplace, she returned to Europe for additional training. Who funded this trip, given her seeming lack of income, is not known.

While on the continent she traveled to France, Holland, and Germany, meeting and charming aviation elites such as famed aircraft designer Anthony Fokker and Robert Thelen, the ninth pilot in

Germany to receive a pilot's license. With each of these dignitaries Bessie would share her desire to fund a flying school to train African American pilots. She promised large orders of ten or twelve planes to each manufacturer she met. None of these orders was ever placed or fulfilled.

The record is silent regarding with whom (if anyone) she received any additional flight training, the stated purpose of the trip. The Dutchman Fokker and the German Thelen both discuss being impressed with Bessie's flying skills. It is possible she received informal instruction from several sources as she promoted not only herself, but her dream of a school.

Bessie's first airshow in the United States was at Curtiss Field outside New York City on September 3, 1922. It was an event designed to honor the all African American 369 Infantry Regiment that was part of the American Expeditionary Force in WWI. Robert Abbott played a key role in getting her the job; promoting her as "The world's greatest woman flyer" (Hardesty, 2008, p. 9).

Bessie was the consummate show person and had a penchant for exaggeration and self-promotion. During her second trip to Europe she had purchased a "uniform" patterned after those worn by the WWI pilots she so admired. Consisting of a leather flying helmet, jodhpurs, high top leather riding boots, Sam Browne belt, and a long leather jacket, she very deliberately struck a swashbuckling pose, designed to emulate the "Knights of the Sky" so popular in American social imagination (Hardesty, 2008, p. 15).

Bessie's dress was both functional in nature and a daring social statement. "The marked gender differences in fashionable dress linked men with seriousness, power, authority and action, and linked women with frivolity, helplessness, compliance and inaction" (Burman, 2000, p. 305). By adopting a pseudo-military uniform, Bessie was sending a clear signal that there was nothing frivolous or helpless in her flying.

Women's dress at the time was designed to ensure modesty with long flowing skirts, high necklines, and covered arms. This type of dress was cumbersome and ultimately dangerous when attempting to fly an aircraft. The chances of a voluminous skirt becoming entangled in the rudder bar or pedals and fouling the controls was very real. Then there is the matter of altitude and airspeed. Air temperature drops predictably with altitude. The higher one flies, the colder it becomes. Bessie's choice of a long leather jacket was as practical as it was stylish; the leather provided a layer of insulation against the cold and a solid barrier against the wind. "For aviators, it was said 'there is nothing like leather, whether for warmth, durability, or impermeability'" (Burman, 2000, p. 309).

The leather flying helmet and goggles were equally necessary. Although her plane was slow by today's standards, it still produced 80 mph – 100 mph of freezing wind. All the aircraft that Bessie flew had open cockpits. Because of this, not only the physical elements, but the thin mist of oil from the engine were constant companions. Becoming blinded by flying debris or oil would mean almost certain death.

A famous picture from this time shows Bessie standing beside a Curtis JN-4, popularly known as the Jenny (Van Der Linden, 2006, p. 44). She is resplendent with stylish but short (bobbed) hair, a button-down shirt and tie, jodhpurs, Sam Brown belt, knee length riding boots, and holding her helmet. Her short stature is emphasized by the fact she is standing on an automobile's running board, yet barely reaches the engine of the aircraft. The Jenny's engine has no cowling and the internal workings are clearly visible. There is a small windscreen in front of the cockpit, but not nearly large enough to provide any meaningful protection from the elements or flying debris. It is no accident that this picture is almost an exact replica of the hundreds of such pictures taken by Allied airmen during the Great War. Bessie

never forgot it was her personality, as much as her piloting skills, that would determine her success or failure on the barnstorming circuit.

Bessie strode a very thin line between rejecting her femininity and profiting from it. Aviation is gendered almost entirely male. The attitudes and characteristics associated with being a pilot are male, and the technocentric aspect of manned flight are all decidedly androcentric. The vocabulary of aviation illustrates this fact. When she flew, Bessie lifted herself into the cockpit of the aircraft, where she fought to control a mechanical beast as willing to kill her as obey her commands. When she exited the aircraft upon landing, it was as a modern-day knight dismounting their steed, handing the reins to a squire while the knight approached the crowd to accept their accolades.

There were no female pilots in the skies over Europe during WWI. No nation allowed women to fly in the military, yet Bessie chose a pseudo-military uniform to represent her character. Her choice of costume is an example of a pattern women attempting to break into male dominated fields have used for centuries: they de-emphasize their femininity. In order to succeed, the woman must be perceived as changing in ways that make them more suited to their male oriented undertaking. Wechsler-Segal, 1995, p. 758). If masculinity is framed as being the opposite of femininity (a truly false dichotomy), then in order to succeed a woman must rid herself of all that is feminine.

Much of Bessie's attire was practical, but other women aviators reached the same goals by binding their dresses around their legs to prevent interference with the flight controls, placing their long hair in a bun and tying their "bonnets" to their head to prevent their headgear from becoming airborne (Burman, 2000, pp. 300–310). Bessie's choice to mimic the uniform worn by male pilots was a powerful statement that she would not be constrained by traditional social norms.

At the same time, she was conscious of the fact that it was her uniqueness as a female aviator that motivated people to come see her show. Bessie was a competent pilot that earned the respect of her colleagues on the barnstorming circuit (Hardesty, 2008). That said, her flying skills would not have been enough to set her apart in an already crowded field. She capitalized on her status as the first African American female pilot to earn a FAI license to fill stadiums with paying spectators, and lecture halls with well heeled customers eager to hear about her exploits.

This careful balancing act is evident in what is perhaps the most recognizable image of Bessie Coleman: the picture from her FAI license. In this head shot, she is wearing her leather pilot's helmet with her goggles perched on her forehead, yet there is an undeniable softness to the photo. The black and white image is slightly blurred and the background almost pastel. She was a strikingly beautiful woman in the classic sense, and not even a bureaucratic identification photograph could hide that reality.

Professor Elizabeth Freyberg (1989) opines that Bessie saw herself as a modern-day Joan of Arc. Just as Joan had united a disparate and often warring group of individual fiefdoms into a coherent military force, Bessie would unite and uplift African Americans out of their subjugation and poverty. "Joan of Arc sought to free her people, the French, from British tyranny and oppression; Coleman … from Anglo American racial tyranny and oppression. Against all odds each chose an avenue to make social changes, yet uncharted by women — Joan the military, Coleman in the field of aviation" (Freydberg, 1989, p. 174). Bessie's emulation of Joan of Arc also shows just how in-tune she was with current affairs. Bessie began associating herself with the French heretic turned saint following her Canonization on May 16, 1920.

After the Curtiss field show, Bessie's next big event was the Negro Tri-State Fair in Memphis, Tennessee. Bessie was the "principal thrill" of the fair's opening day, October 12, 1922. Recalling this show, Bessie boasted to have flown before 20,000 spectators. In reality, 20,000 was the attendance for the full three days of the fair. The Memphis Commercial Appeal praised her for her "nervy flying," and

gushed that Bessie proved so great a draw that the organizers should have booked her "for a dozen shows" (Rich, 1993, p. 51).

With two successful airshows under her belt, "Queen Bess, Daredevil Aviatrix" was eager to return home to Chicago. Her first show in front of a home crowd was at Checkerboard Airdrome (Midway Airport). This show had originally been planned for Labor Day, but had to be rescheduled because of rain. She was to give a total of four flights, beginning at 3 pm.

The preshow publicity provided by the *Chicago Defender* was as over the top as their main attraction. Abbott's paper declared that Bessie had "amazed continental Europe and been applauded in Paris, Berlin, and Munich." It went on to explain that

> Her flight will be patterned after American, French, Spanish and German methods. The French Nungesser start will be made. The climb will be after the Spanish form of Berta Costa and the turn that of McMullen in the American Curtiss. She will straighten out in the manner of Eddie Rickenbacker and execute glides after the style of the German Richthofen (sic). Landings of the Ralph C. Diggins type will be made. (Rich, 1993, p. 54)

The names used in this release would have been familiar to most aviation enthusiasts at the time. Nungesser, McMullen, Rickenbacker, Richthofen and Diggins were all World War I aces. Eddie Rickenbacker being a Medal of Honor recipient and the highest scoring American ace of the war with 26 aerial kills. The "German Richthofen" was the infamous Manfred von Richthofen, the German "Red Baron," with 80 air combat victories.

The article misidentified the "Spanish" Berta Costa. Bertrand Acosta was an American aviation pioneer and protégée of Glenn Curtiss. By 1917 he was the "Chief Pilot Instructor and Director of Flying and Engineering for the Army Air Service. He was solely responsible for pilot testing, rating other engineers, and approving all planes seeing combat in World War One" ("Acosta, Bertrand 'Bert' B," 2019). Acosta went on to pilot the aircraft Admiral Richard Byrd used to cross the Atlantic in 1927.

Admission for the show was $1 for adults and 0.25 cents for children, a sizable sum in 1922, equivalent of $15 today. While Abbott publicized the show, it was a white businessman, David L. Behncke, who provided the plane and airfield. Behncke was a very prominent figure in the early days of aviation. He owned and operated Checkerboard Airdrome and its associated repair shop and charter service. A former Army Air Service flight instructor, Behncke was five years Bessie's junior, and had "no reservations about Bessie's race or gender" (Rich, 1993, p. 55). Behncke would later go on to head the influential Air Line Pilots' Association (ALPA), a positon he held for over 20 years (Cohen, 2000).

Bessie used the Curtiss JN-4 "Jenny" for her airshow theatrics. Although it never saw combat, the JN-4 is one of the most famous aircraft of the time. "More than 90% of American pilots trained during the First World War received their primary instruction on the Jenny" ("Curtiss JN-4D Jenny," 2019). Following the war, thousands were sold as surplus on the civilian market. They became the most common aircraft used on the barnstorming circuit.

The Jenny was similar to the Nieuport trainer Bessie had used in France. Both were made of wood and fabric and had a reputation for being fairly forgiving aircraft. The main difference was the Jenny had a much larger engine, 150 horsepower, compared to 80 horsepower for the Nieuport (Murphy, 2005).

Two thousand people came to Checkerboard Airdrome to watch her perform, including her mother, and sisters and their children. Her nephew was beside himself with pride, "My aunt's a flier!"

and "she's just beautiful wearing that long leather coat over uniform and the leather helmet with aviator goggles! That's my aunt! A real live aviator" (Rich, 1993, p. 56).

The African American press was generally generous in their praise, but the mainstream media was less consistent. In 1922, Bessie accepted a role in a full-length motion picture titled *Shadow and Sunshine*. The initial reaction was lavish. Billboard magazine wrote a long piece detailing how the film would be produced by the African American Seminole Film Company, and result in the hiring of over 100 African American extras (Hardesty, 2008). This gushing praise quickly turned to scorn when Bessie withdrew over the opening scene. She was told she would appear "dressed in tattered clothing and with a walking stick and a pack on her back, to portray an ignorant girl just arriving in New York." Bessie refused. "No Uncle Tom stuff for me" (Rich, 1993, p. 57).

Billboard's reaction was quick and caustic. J.A. Jackson, a Billboard film critic and columnist said, "Miss Coleman is originally from Texas and some of her southern dialect and mannerisms still cling to her." In a subsequent piece, he continued along the same vein. He described the actor replacing Bessie as being experienced, and possessing "unmistakable culture and social status, which will be an asset to the company" (Rich, 1993, p. 58). Bessie never received another film role, and even had trouble booking appearances at African American fairs in parts of the South and Midwest. She had obtained the reputation of being "unreliable" (Rich, 1993, p. 59).

Bessie's actions resulted in her fighting a war on two fronts. It is clear her exit from *Shadow and Sunshine* was principled. She refused to perpetuate derogatory stereotypes. She was also fighting as a woman in an economic system that remained misogynistic even within the African American community (Hardesty, 2008, p. 15.). The producers never forgave her backing out and refused to sign her for their shows. After this episode, "she launched into a search for new backers. If show-business people on the East Coast would not give her a break, she would look elsewhere" (Rich, 1993, p. 62).

Since returning from Europe, Bessie's one true passion was opening an aviation school for African American students of either sex (Williams, 2013). This was truly her calling and obsession. She wanted to turn "Uncle Tom's cabin into a flying hangar" (Ivery, 2002). As with most of her endeavors, money was the main obstacle to reaching her goals. Following the Shadow and Sunshine affair Bessie had no steady means of support. She did not have a benefactor, a plane, or any solid future engagements.

Bessie boarded a train for California, where she worked for Coast Tire and Rubber Company dropping leaflets about their tires. Using the money she made from these flights, she purchased a surplus JN-4 at the Rockwell Army Intermediate Depot on North Island at Coronado. While at Coronado Bessie was interviewed by a reporter for the *Air Service Newsletter*, and influential trade publication. She explained her desire to open a school for African American students and boasted that she had ordered three planes (instead of one) which were to be delivered and assembled in San Francisco.

Despite her history of exaggeration, the reporter took her claims at face value and reported them as true. "When Bessie spoke as a pilot she became an actress on stage, uttering fictional lines with total conviction." Although she did not lie to family or friends, her misstatements to the media and supporters was a tool she used whenever she thought it advantageous (Rich, 1993, p. 66). In her mind, the con was simply part of her persona.

In an age before internet fact checking, Bessie was free to create her own history. In an interview with the *California Eagle*, and African American weekly, she gave her age as 23 (she was 31), stated she had flown in six European countries (the actual number was three), and held German as well as French flying credentials (FAI is the only pilot certificate she ever held). She also claimed to be the only woman

to hold a FAI certificate. Bessie was the only African American woman to hold a FAI; there were other European women pilots with the same credential.

Once her JN-4 was ready, she started looking for places to hold exhibitions. Southern California was a hotbed aviation activity following the war, so traditional barnstorming would not have attracted much of a crowd. Bessie would have to rely on her carefully crafted persona to set her apart. The specter of an African American female pilot was too great to pass up and 10,000 people had gathered to watch her fly.

Once again disaster struck. Enroute to the show in Palomar Park, the Jenny's engine quit shortly after takeoff from Santa Monica and crashed. Bessie was unconscious when pulled from the wreckage. She had also broken her leg, several ribs, and had multiple lacerations and abrasions around her eyes (Ivery, 2002). Bessie was in the hospital for three months and was still wearing a cast on her leg when discharged.

Strapped for cash and without an airplane, Bessie arranged to give five lectures at the Ninth Street Young Man's Christian Association (YMCA) in Los Angeles. At these lectures, she showed films of her travels in Europe and described her exploits. Admission was 25 cents for children and 50 cents for adults (Rich, 1993, p. 73). She returned to Chicago in late June 1923 determined to arrest the downward spiral her career had taken since the crash.

Bessie's first show following the crash was to be on Labor Day in Columbus, Ohio but the show was rained out. In a sad irony, several thousand people, as many women as men met at the state fairgrounds a few miles away for an all day celebration of the Ku Klux Klan, "their enthusiasm undampened by the rain that was washing Bessie's show off the calendar" (Rich, 1993, p. 76). Bessie returned to Columbus a week later and flew before a crowd of 10,000.

What had always been unique regarding her shows was the demand that all spectators, white and black, enter through the same gate. Bessie would not fly before a segregated audience. It is a testament to her drawing power that in a place as steeped in racial hatred as Columbus Ohio in 1923, not only did the mayor welcome Bessie, there was only one entrance for all guests (Creasman, 1997; Ivery, 2002; Staurowsky, 2007).

It would be inaccurate and unfair to place all of Bessie Coleman's problems at the feet of racism, bigotry, and institutionalized misogyny. In many ways, Bessie was her own worst enemy. She hired and fired five managers in a period of two years and was often "temperamental and demanding" (Hardesty, 2008, p. 16). She was uncommunicative with her staff and made arrangements for appearances that conflicted with previously agreed to engagements. In the end her penchant for exaggeration (lying) and her willingness to change plans at the last minute, leaving venue promoters without a headliner after advertising money had been spent and tickets sold, severely sullied her reputation within the industry. Very few big-name promoters would hire her.

Despite her shortcomings, Bessie was a celebrity in Chicago and among the African American community. The problem was this celebrity did not equate to a steady income and she was perpetually worried about money. These shows produced a subsistence lifestyle that nonetheless kept her fed and clothed and provided her family with a sense of prestige. "In their eyes she was famous and because of that all the Coleman's had gained status" (Rich, 1993, p. 79).

In May 1925, Bessie returned to Texas for the first time. Staying in Houston, she gave lectures and worked to arrange a flying demonstration. Bessie's willingness to lie in order to promote an event was evident in the preshow publicity published by the Houston Post-Dispatch, a white daily. Giving her

age as 23 and claiming she had received flight training in Amsterdam, Berlin, Paris and "elsewhere;" she insisted that her shows were an attempt to change the fact that "The Negro race is the only race without aviators and I want to interest the Negro in flying and thus help the best way I'm equipped in to uplift the colored race" (Rich, 1993, p. 85).

This first Texas show was unique in two ways: it happened on Juneteenth, a celebration of the Emancipation Proclamation, and was segregated: "special reservations" (separate seating) for white guests. Juneteenth celebrates the end of slavery in the United States. On June 19, 1865 Major General Gordon Granger arrived in Galveston, Texas ad announced the end of the Civil War and the end of slavery. "Although the Emancipation Proclamation came 2 ½ years earlier on January 1, 1863, many slave owners continued to hold their slaves captive after the announcement, Juneteenth became a symbolic date representing African American freedom" (Higgins, 2017, p. 1).

In addition to her normal airshow, Bessie and four other pilots made it possible, "for the first time" for the "colored public of the South … to fly." Houston's leading black newspaper, the Houston Informer, noted "about 75 of our fearless citizens, most of whom were women," climbed aboard one of the five small passenger planes available to get "a birds—eye view of Houston from the sky" (Rich, 1993, p. 88).

The Houston show was so successful that three additional shows in and near Houston were held over the next month. Bessie also gave several lectures extolling the African American citizens of Texas to take an interest in aviation. She aimed these lectures at the women in the audience, knowing that "the white, male-dominated society found it easier to accept assertive black females than to accept the same characteristic in black males" (Rich, 1993, p. 90). Black women did not threaten white masculinity to the level confident African American men did.

It was during these lectures that Bessie began to wonder if perhaps the lecture circuit, rather than barnstorming, might be more effective in preaching the gospel of aviation and drumming up support for her long dreamed of school. Bessie never charged students admission for her lectures, hoping to inspire them to be pilots.

It was at an airshow in Wharton, Texas, eighty miles southwest of Houston on September 6, 1925 that Bessie added parachuting to her repertoire. Bessie had used parachutists before in her show, and after one refused to jump anymore, Bessie decided to do it herself. With a hired pilot from Houston at the controls, Bessie jumped, landing in the center of the crowd (Hardesty, 2008).

At a show in her hometown of Waxahachie, Bessie refused to perform unless all spectators entered through the same gate. Texas had the most restrictive Jim Crow laws in the South, and this concession by event organizers speaks volumes to Bessie's commercial appeal at this time.

After her triumphant tour of her home state, Bessie returned to Chicago where she worked with her agent to put together a speaking tour of Georgia and Florida. Bessie's lectures in Georgia were met with great fanfare. Although she promised to return to several locations to give a flying demonstration, this was not possible since she did not own an airplane.

Bessie received an even warmer welcome in Florida, where she stayed with the Reverend Hezekiah Keith Hill and his wife Viola Tillinghast Hill. The Hill's thought Bessie's message was of great import to the African American community of Orlando, and invited her to stay with them in the parsonage of Reverend Hill's church (Rich, 1993, p. 101). It was with the Hill's that Bessie found a new family and faith. She referred to the Reverend and Mrs. Hill as "Mother" and "Daddy," and became a Born-Again Christian under their guidance.

As in Chicago, Bessie was a celebrity in the African American community of Orlando. Popular among the children, she was a frequent speaker at African American schools, thrilling the children with tales of her exploits. Bessie also spoke to adults in any venue that would host her. Theatres, churches, and pool halls were all enlisted for this purpose. She spoke for either a small fee or by passing the hat, depending on the venue. Despite her popularity, one thing was certain, she would never earn enough to open her school by speaking engagements alone (Rich, 1993, p. 104).

Against the objections of Viola Hill, who did not want Bessie doing any more airshows, Bessie booked a performance at the Orlando Chamber of Commerce's annual flower show. Once again, Bessie's refusal to perform before a white's only or segregated audience resulted in friction with event organizers. Like Texas, Florida was rigidly segregated and overtly violent towards African Americans. In Daytona Beach, African Americans could not be on the street after dark without a special transit pass, and in Tampa "Night Riders" terrorized African American residents into selling their houses and leaving the city (Rich, 1993, p. 105).

Dr. David Ortiz, in his study of African American resistance in Florida in the late nineteenth and early twentieth century makes it plain, "African Americans who raised their voices placed themselves in mortal danger" (Ortiz, 2000, p. 73). Between 1882 and 1930, African Americans in Florida suffered the highest lynching rate per capita in the United States. During those years, at least two hundred and sixty-six African Americans were lynched (Ortiz, 2000, p. 85). As in other venues, it is a testament to Bessie's economic power that the Orlando Chamber of Commerce integrated the flower show and agreed to allow all spectators to enter through a single gate.

Bessie then agreed to fly at the annual May Day celebration sponsored by the Negro Welfare League in Jacksonville (Freydberg, 1989, p. 155). This invitation was especially meaningful to Bessie. Although she was revered in the African American community, none of the prominent African American civic organizations had come out in support of her idea for a school for African American aviators. With this invitation she was hoping to gain the financial backing that had so far eluded her.

> This was not to be. On the day before the show John T. Betsch, Coleman's Florida publicity manager, a Howard graduate interested in aeronautics, and member of the Jacksonville Negro Welfare League, accompanied Coleman and Wills [Bessie's Mechanic] at 7:15 A.M. to the Paxon Airfield on Friday, April 30 [1926], for a dress rehearsal of the impending performance. Before entering the cockpit, Coleman knelt in prayer beside the aircraft. When she arose she promised to take Betsch up after she test piloted the plane. Wills was piloting the plane as a few spectators watched the plane soaring in graceful patterns against the early morning sun. Suddenly the graceful circles turned into wildly, uncontrolled circles and the plane began to descend rapidly from the air into a sharp nosedive toward the ground. Bessie Coleman was catapulted out of the machine at about 2,000 feet when the plane somersaulted in several revolutions; she was not wearing a seatbelt or a parachute … her body was found in a farm yard owned by Mrs. W. L. Meadows almost a mile from where the plane crashed, every bone in her body been crushed by the impact. (Freydberg, 1989, p. 156)

Wills, who was wearing a seatbelt, remained with the aircraft until it crashed near the end of the airfield. Betsch quickly ran to the wreckage, where in his excitement he struck a match to light a cigarette to calm his nerves. The match ignited the fuel vapors surrounding the wrecked plane and cremated Wills with the remains of the damaged aircraft. Betsch was arrested but released after several hours, because no malice was found in his actions; rather, they were attributed to confusion and panic after having witnessed such a horrific event (Freydberg, 1989, p. 157).

Following the crash, many in the African American community believed Wills guilty of murder. They believed that had it not been for Betsch's unfortunate decision to lite a cigarette, Wills would have lived. The most noteworthy proponent of this conspiracy theory was Robert Abbott of the Chicago Defender, who insisted that Bessie not fly with Wills because he, "didn't like the looks of the Texan" (Rich, 1993, p. 109). These rumors and conspiracy theories were largely abandoned after a wrench was found in the wreckage, and it was determined that it was this wrench, not Wills, that caused the loss of control that resulted in Bessie's death (Freydberg, 1989, p. 158; Rich, 1993, p. 111).

The impact of Bessie's death on the African American community can be seen in the three separate funerals held in her honor. Denied other forms of homage, funerals in the African American community have always been an integral part of the community's consciousness. They were a way for the community to come together to celebrate not only the deceased, but themselves. Funerals were an occasion where large numbers of African American citizens could gather without attracting the ire of the dominant white community. They were an African American space largely free of white interference (Bunch-Lyons, 2015).

In Jacksonville, mourners filed past her closed coffin at the funeral home until well after midnight. On Sunday, May 2, 1926, more than 5,000 members of Jacksonville's African American community showed up at her funeral to pay their final respects. Several hundred of the mourners were school children who had heard Bessie speak the day before her death (Rich, 1993, p. 112).

After the services in Jacksonville, Bessie's body was moved by train to Orlando, where a second service was held on Monday May 3. Bessie's friend and surrogate father, the Reverend Hezekiah Hill gave the eulogy. Following this service, Bessie's body was moved by train to Chicago, accompanied by Viola Hill; the wife of Reverend Hill and the woman who had tried unsuccessfully to dissuade Bessie from performing in anymore air shows (Freydberg, 1989, p. 159).

Bessie's body arrived in Chicago on May 5 and laid in state until her final send-off on Friday, May 7. More than 10,000 people paid their respects during that time. At the Chicago funeral, her flag draped casket was carried by six actual and twenty-four honorary pallbearers. Those that spoke in her honor emphasized her courage and indomitable spirit. They also highlighted her integrity and unflinching loyalty to her race. Although she was offered large sums of money to "give exhibitions exclusively for the other race, she steadily refused to accept them unless her people were allowed admission" (Freydberg, 1989, p. 161).

Bessie Coleman's legacy is as complicated as the woman who spawned it. She was loved by the rank and file of the African American community but lived mostly unsupported by its financial leaders – Robert Abbott being the most notable exception. At her funeral in Chicago, the Reverend Junius C. Austin, described Bessie as "100 years ahead of the race she loved so well, and by whom she was least appreciated" (Freydberg, 1989, p. 161).

Bessie was born a poor woman of color in one of the most aggressively segregated states in America; yet against all odds went on to become the first African American of either sex to earn a FAI. Despite this accomplishment, she was never able to realize her dream: an aviation school to serve the African American community. Bessie Coleman flaunted the socio-sexual mores of the time and this in turn was used against her to undermine her legitimacy. She slept her way to the top was the most common gossip heard among those jealous or angry at her success.

A tireless self-promoter, Bessie never let the truth get in the way of a good story; a failing the media often enabled by printing her assertions without any attempts to verify her claims. She saw herself

as Joan of Arc and worked deliberately to draw parallels between her own strident African American Nationalism and the ardent nationalism of the Maid of Orleans.

Bessie was very much in tune with the racial realities of her segregated world. She believed that white America was willing to accept the type of assertive behavior she became notorious for because she was a woman. Had she been an African American man, she would have been stopped and quite possibly killed. Bessie "knew that the white, male dominated society found it easier to accept assertive black females than to accept the same characteristic in black males" (Rich, 1993, p. 90). This is a reversal of normal gender roles due to race, and speaks volumes about the South's continued fear and paranoia of African American male equality.

As a vehicle of social control, gender does not exist in isolation. Rather, it cooperates synergistically with other avenues of control such as race, religion, and socioeconomic status to perpetuate and maintain the status quo. Any attempt to alter the prevailing power structures is met head on, often violently, by those actors with the most to lose.

This dynamic is evident throughout Bessie's life. Born in abject poverty, her dreams of flight were thwarted not only by economics, but race and gender as well. As a child she was relegated to a segregated rural school that lacked almost all necessities, including qualified staff. By the time she graduated, Bessie was as literate as her instructor.

As Bessie planned for her escape, she was forced to "remember her place" when picking up or delivering other people's laundry on the west side of Waxahachie. Her status as "other" was reinforced during her trip to Chicago in rail car designed for human cattle. Once with her brother she was faced with the reality that she had exchanged Jim Crow for the self-imposed segregation on State Street.

It was in France that Bessie first felt the loosening of the social constraints that had dominated her life to this point. France between World War I and World War II was the New Jerusalem in the minds of many African Americans. Here race did not automatically mean exclusion, and the sexual taboos so common in America were less prominent. Race and gender are both social constructs. They change according to when and where they are created.

Bessie's professional career was a continual balancing act between being restricted, and profiting from her uniqueness. Bessie walked this tight rope expertly. She was very attuned to the power of symbols and the subconscious messages they telegraphed. Her choice of dress was a delicate balance between practical considerations and profound social statements. Outfitted as a military aviator, Bessie at once hid and flaunted her femininity. Flying, like the military, is gendered almost entirely male and Bessie's uniform paid homage to this reality. Yet, there is no denying her heteronormative, even exotic appeal. The conflicting signals were intentional. Bessie refused to be categorized in any traditional way.

Bessie's refusal to perpetuate derogatory stereotypes or perform before segregated audiences is another example of this delicate balancing act. Had Bessie agreed to play her role in Shadow and Sunshine, there is little doubt her financial situation would have been more secure; she may even have made enough to realize her dreams of a flight school. Her refusal to play a role she saw as demeaning plagued her throughout the rest of her career. Likewise, her refusal to perform before segregated audiences severely restricted the shows she was able to book. That said, it is precisely this integrity that endeared her in the hearts of so many African American audiences. Her ability to demand and receive concessions from white promoters in Jim Crow South is astounding. Very few African American performers can claim this distinction. This single fact makes Bessie Coleman matchless among her peers.

Gender is ubiquitous. It is everywhere and influences everything. Yet gender does not operate in isolation. Factors such as race, religion, and socioeconomic status also conspire to maintain social control. Bessie Coleman embraced and overcame all these factors in order to understand that "the air is the only place free from prejudice" (Nash, 2015).

References

Acosta, Bertrand "Bert" B. (2019). In *National Aviation Hall of Fame*. Retrieved from https://www.nationalaviation.org/our-enshrinees/acosta-bertrand-bert-b/

Arestis, P., Charles, A., & Fontana, G. (2014). Identity Economics Meets Financialisation: Gender, Race and Occupational Stratification in the US Labour Market. *Cambridge Journal of Economics, 38,* 1471–1491. https://doi.org/10.1093/cje/beu024

Blair, C. M. (2014). African American Women's Sexuality. *Frontiers: A Journal of Women's Studies*, *35*(1), 4–10.

Bunch-Lyons, B. (2015). "Ours is a Business of Loyalty": African American Funeral Home Owners in Southern Cities. *Southern Quarterly, 53*(1), 57–71.

Burman, B. (2000). Racing Bodies: Dress and Pioneer Women Aviators and Racing Drivers. *Women's History Review, 9*(2), 299–326.

Cameron, R. H. (1999). *Training to Fly: Military Flight Training 1907-1945*. Air Force History and Museums.

Chicago Defender. (2019). In *Britannica Academic*. Retrieved from https://academic-eb-com.ezproxy1.lib.asu.edu/levels/collegiate/article/Chicago-Defender/2511

Cohen, I. (2000). David L. Behncke, The Airline Pilots, and the New Deal: The Struggle for Federal Labor Legislation. *Labor History, 41*(1), 47–62.

Creasman, K. (1997). Black birds in the sky: The legacies of Bessie Coleman and Dr. Mae Jemison. *The Journal of Negro History*, *82*(1), 158–168.

Curtiss JN-4D Jenny. (2019). In *Smithsonian National Air and Space Museum*. Retrieved from https://airandspace.si.edu/collection-objects/curtiss-jn-4d-jenny

Desantis, A. (1997). A Forgotten Leader. *Journalism History*, *23*(2), 63–71.

DeSantis, A. (1998). Selling the American Dream Myth to Black Southerners: The Chicago Defender and the Great Migration of 1915-1919. *Western Journal of Communication, 62*(4), 474–511. https://doi.org/10.1080/10570319809374621

Finler, J. (2003). *The Hollywood Story*. Wallflower Press.

Finnegan, T. (2014). Politics of Defiance: Uncovering the Causes and Consequences of Lynching and Communal Violence. *Journal of American History*, *101*(3), 850–851.

Freydberg, E. A. H. (1989). *Bessie Coleman: The Brownskin Lady Bird* (Dissertation). Indiana University.

Gates, Stunt Flier, Ends Life By Leap: Founder of Flying Circus Jumps out Window as Wife Tries to Hold Him Back. (1932, November 25). *New York Times*, p. 16.

Gill, T. (2010). *Beauty Shop Politics: African American Women's Activism in the Beauty Industry*. Urbana: University of Illinois Press.

Hardesty, V. (2008). *Black Wings: Courageous Stories of African Americans in Aviation and Space History*. Washington, DC: Smithsonian National Air and Space Museum.

Henri, F. (1975). *Black Migration: Movement North, 1900-1920*. Anchor Press/Doubleday.

Higgins, M. (2017). *Juneteenth: Fact Sheet* (No. R44865; p. 7). Congressional Research Service.

Hodes, M. (1993). The Sexualization of Reconstruction Politics: White Women and Black Men in the South After the Civil War. *Journal of the History of Sexuality*, *3*(3), 402–417.
Inflation Calculator. (2019). Retrieved from https://www.dollartimes.com/inflation/inflation.php?amount=1&year=1922

Ivery, R. (2002, March 13). Bessie Coleman, The First Black Woman Aviatior. *Miami Times*.

Kitchens, J. (2003). Barnstorming. In *Dictionary of American History* (3rd ed., Vol. 1, p. 418). New York: Charles Scribner's Sons.

Knight, A. (2010). D.W. Griffith's "The Birth of a Nation": A History of "The most Controversial Motion Picture of All Time." *Film Quarterly*, *64*(1), 78–79.

Ku Klux Klan. (n.d.). In *Encyclopaedia Britannica* (Britannica Academic). Retrieved from https://academic.eb.com/levels/collegiate/article/Ku-Klux-Klan/46315

Meszaros, J., & Bazzaroni, C. (2014). From Taboo to Tourist Industry: The Constructin of Interracial Intimacies Between Black Men and White Women in Colonial and Contemporary Times. *Sociology Compass*, *8*(11), 1256–1268.

Murphy, J. . (2005). Aircraft, Reconnaissance and Auxiliary. In *World War 1: Encyclopedia* (2nd ed.). Retrieved from https://login.ezproxy1.lib.asu.edu/login?url=https://search.credoreference.com/content/entry/abcwwi/aircraft_reconnaissance_and_auxiliary/0?institutionId=2261

Nagel, J. (2000). Ethnicity and Sexuality. *Annual Review of Sociology*, *26*, 107–133.

Nash, T. (2015). Biography: Bessie Coleman - The First Aviatrix. In *The Heroine Collective*. Retrieved from http://www.theheroinecollective.com/bessie-coleman-the-first-aviatrix/

Norwood, C. (2018). Mapping the Intersections of Violence on Black Women's Sexual Health within the Jim Crow Geographies of Cincinnati Neighborhoods. *Frontiers (Boulder)*, *39*(2), 97–135.

Ortiz, P. A. (2000). *"Like Water Covered the Sea": African American Freedom Struggle in Florida, 1877-1920* (Dissertation). Duke University.

Pfister, G. (1990). The Medical Discourse on Female Physical Culture in Germany in the 19th and early 20th Centuries. *Journal of Sport History*, *17*(2), 183–198.

Pitcher, C. (1999). D.W. Griffith's Controversial Film, The Birth of a Nation. *Magazine of History*, *13*(3).

Rice, T. (2016). *White Robes, Silver Screens: Movies and the Making of the Ku Klux Klan*. Indiana University Press.

Rich, D. L. (1993). *Queen Bess Daredevil Aviator*. Washington, DC: Smithsonian Institution Press.

Roberts, D. (1998). *Killing the Black Body: Race, Reproduction, and the Meaning of Liberty*. New York: Vintage Books, an imprint of Knopf Double Day.

Rogin, M. (1985). "The Sword Became a Flashing Vision": D. W. Griffith's The Birth of a Nation. *Representations*, *9*, 150–195.

Sanger, R. (2002). *Nieuport Aircraft of World War One*. Crowood.

Staurowsky, E. J. (2007). Coleman, Bessie. In *Berkshire Encyclopedia of Extreme Sports*. Retrieved from https://search.credoreference.com/content/entry/berkextsp/coleman_bessie/0?institutionId=2261

Thompson-Miller, R., & Picca, L. H. (2017). "There Were Rapes!": Sexual Assaults of African American Women and Children in Jim Crow. *Violence Against Women*, *23*(8), 934–950. https://doi.org/10.1177/1077801216654016

Travis, D. (2014). *An Autobiography of Black Chicago*. Agate Bolden.

Van Der Linden, F. R. (2006). *Best of the National Air and Space Museum*. Washington, DC: Smithsonian National Air and Space Museum.

Wade, C. (2010). African American Entrepreneurs: Integration, Education, and Exclusion. *Western New England Law Review, 32*(3), 483.

Wechsler-Segal, M. (1995). Women's military roles cross-nationally: Past, present, and future. *Gender and Society*, *9*(6), 757–775.

Whalan, M. (2005). "The Only Real White Democracy" and the Language of Liberation: The Great War, France, and African American Culture in the 1920s. *MFS Modern Fiction Studies*, *51*(4), 775–800.

White-robed Klan cheered on march in nation's capital. (1925, August 9). *Washington Post*.

Whittall, N. (2019). Federation Aeronautique Internationale (FAI). In *Britannica Academic*. Retrieved from https://academic-eb-com.ezproxy1.lib.asu.edu/levels/collegiate/article/F%C3%A9der%C3%A1tion-A%C3%A9ronautique-Internationale/343176

Williams, J. K. (2013, March). Elizabeth "Bessie" Coleman: The Original Fly Girl. *New York Amsterdam News*. Retrieved from http://login.ezproxy1.lib.asu.edu/login?url=https://search-proquest-com.ezproxy1.lib.asu.edu/docview/1412225067?accountid=4485

Wright, R. (1991). *Uncle Tom's Children* (5th ed.). Library of America.

University Aviation Association
2787 N. 2nd St.
Memphis, TN 38127
(901) 563-0505
hello@uaa.aero