P11. Fit to Fly: An Investigation of Aeronautical Decision Making for Pilots

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Maria Abela[1] and Dr Katya De Giovanni[2]

Faculty for Social Wellbeing University of Malta, Malta

Abstract. This quantitative study adopts a positivistic research paradigm in order to investigate the perspective of pilots towards aeronautical decision-making (ADM) across three different dimensions: commercial and recreational pilots, three different age brackets (under 25, between 25-50, and more than 50 years) and three different amounts of flying hours (under 1000, between 1000-5000, and more than 5000 flying hours). A total of 117 pilots participated in this study, through the completion of a constructed questionnaire, consisting of 35 items. Results from the independent-samples *t*-test demonstrated a significant difference in the impact of "Macho" hazardous attitude, "Personal issues", "Time of day" and "Aircraft acceptance before flight" on ADM between commercial and recreational pilots. Results from the questionnaire exhibit a significant difference in the effect of "Psychological services may be beneficial to pilots and should be made available by aviation companies", "Time of day" and "Aircraft acceptance before flight" on ADM between different age groups. Furthermore, results illustrate a significant difference in the effect of "Macho" hazardous attitude and "Commercial pressures" on ADM between pilots having different amounts of flying hours.

Keywords: aviation psychology, aeronautical decision making, commercial, recreational, age, experience

Introduction

Several advancements in aviation technology, have resulted in safe, state of the art aircraft. Some of the aircrew are considered to be more dangerous than the airplane itself (Mason, 1993 as cited in Murray, 1997). Safety organisations within the aviation sector encounter the challenge of improving an already very safe industry (Shappell et al., 2006).

According to the Federal Aviation Administration (FAA) Advisory Circular (AC) 60-22 (1991) "ADM is a systematic approach to the mental process used by aircraft pilots to consistently determine the best course of action in response to a given set of circumstances" (p.2) Therefore, in order to reduce errors, the investigation of ADM is crucial. Several decision-making errors occur due to pilot attitudes (Berlin et al., 1982). When good decision-making skills are applied, the built-in risk associated with each flight is greatly diminished or abolished (FAA, 2016). Orasanu, Martin and Davison (1998) imply that the company's emphasis on efficiency may inadvertently conflict safety. When flying task requirements exceeds pilot capabilities, the possibility of an accident occurring increases (FAA, 2016).

The introduction of ADM training in the curriculum resulted in about 10% to 50% reduction in judgement errors (FAA, 2016). In an aeronautical operational setting, aircrew members are continuously confronted with decisions (Orasanu, 2010). Unfortunately, the decisions that receive the utmost attention by the media are those that end in catastrophes (Orasanu, 2010). The process of decision-making involves a lot of mental energy (Billings, 1991). According to Billings (1991), FAA and European Aviation Safety Agency (EASA), attempt to simplify the decision-making process of the flight crew, by means of standard procedures and checklists. According to Li and Harris (2001), programmes aimed at training pilots in using ADM mnemonics, eventually attained significant increase in flight safety.

The current study

The aim of this research was to compare and contrast the perspective of pilots towards ADM. Three research questions were formulated for the basis of this research. These questions analysed ADM from three different dimensions as mentioned below;

- Is there a difference in the perspective of ADM between commercial and recreational pilots?
- Is there a difference in the perspective of ADM between pilots in different age groups?
- Is there a difference in the perspective of ADM between pilots having different amounts of flying hours?

In order to answer the research question, three null hypotheses were constructed and presented below;

-*H0*: There is no difference in the perspective of ADM between commercial and recreational pilots

-*H0*: There is no difference in the perspective of ADM between different age brackets (under 25, between 25-50, and more than 50 years).

-*H0*: There is no difference in the perspective of ADM between different amounts of flying hours (under 1000, between 1000-5000, and more than 5000 flying hours).

Methodology

This study adopted a quantitative approach with a positivistic research paradigm. Applying a quantitative approach enabled feedback to be attained from various countries and pilots from different background. Participants in this study were asked to complete the constructed questionnaire, in order to gather the necessary data for analysis so as to test the stated hypothesis. In the initial process of recruiting participants, a purposive sampling technique was utilised. Aviation bodies with pilot populations were contacted and asked to forward the questionnaire to those holding a valid pilot license. Two major airlines and one of the Maltese based aviation academy were requested to circulate the questionnaire among their previous and current pilot contacts. The initial purposive sampling technique, facilitated the induction of a second sampling phase, the snowball sampling technique. This enabled the benchmark of $N = 100$ to be surpassed within a few weeks.

Participants

A total of 117 pilots participated in this study, 56.4% of whom were commercial pilots and 43.6% were recreational pilots. When divided according to age, commercial pilots consisted of 6.1% under 25 years, 60.6% between the age of 25 to 50 years and 33.3% over 50 years. When divided according to flying hours, commercial pilots incorporated 3% under 1000 flying hours, 36.4% between 1000 to 5000 flying hours and 60.6% with more than 5000 flying hours. Recreational pilots were also divided into age groups and flying hours. When divided according to age, recreational pilots consisted of 19.6% under 25 years, 33.3% between the age of 25 to 50 years and 47.1 % over 50 years. When divided according to flying hours, recreational pilots incorporated 78.4% under 1000 flying hours, 15.7% between 1000 to 5000 flying hours and 5.9% with more than 5000 flying hours.

Research tools

The especially-constructed questionnaire consisting of 35 items was distributed electronically. Items administered were close-ended, declarative, multiple-response and likert-5-point scale types ranging from 1 (*strongly disagree*) to 5 (*strongly agree)*. This was applied in order to allow a certain degree of opinion.

Data Analysis

Version 24 of SPSS Software Package was utilised for data analysis. The independent samples *t*-tests were utilised, in order to compare two means acquired from independent groups. Through the use of one-way ANOVA, variance was compared in order to identify significant differences. Once a statistical significance was noted, further analysis was conducted by the Student-Newman-Keuls and Least Significant Difference (LSD) post hoc tests. Reliability testing by Cronbach's Alpha was computed in order to assess internal consistency indicating moderately good to excellent internal consistencies. Frequency data tables were utilised in order to gather information from multiple response and declarative questions. Furthermore, mean data graph was utilised to compare data of different phases, covering a grouped set of related questions

The null hypotheses were rejected for mean rating scores having p value less than the .05 criterion. Whilst the null hypotheses were accepted for mean rating scores having p value exceeding the .05 level of significance. From the questionnaire, no item resulted in the rejection of all three null hypotheses.

Results

Independent-samples T-test

An independent-samples *t*-test was conducted in order to compare mean rating scores provided to a number of items between commercial and recreational participants. This section includes results from independent-samples *t*- test for questions having a *p* value less than the .05 criterion. Questionnaire items "Macho" (p = .023), "Personal issues" (p = .006), "Time of day" (p = .013) and "Aircraft acceptance before flight" (p = .048) were noted as having a *p* value less than the .05 criterion.

There was a significant difference in "Macho" hazardous attitude scores for commercial flying (M = 4.11, SD = 1.083) and recreational flying (M = 4.53, SD = 0.83) conditions; t (115) = -2.31, p = .023. Results suggest that recreational pilots consider "Macho" hazardous attitude more hazardous than commercial pilots.

There was a significant difference in "Personal issues" scores for commercial flying (M= 3.52, SD = 1.09) and recreational flying (M = 4.06, SD = 0.96) conditions; t (115) = -2.794, p = .006. Results suggest that the impact of personal issues on decision-making is greater for recreational pilots than for commercial pilots.

There was a significant difference in "Time of day" scores for commercial flying (M = 3.62, SD = 0.98) and recreational flying (M = 3.14, SD= 1.07) conditions; t (115) = 2.52, p = .013. Results suggests that the impact of time of day on decision-making is greater for commercial pilots than for recreational pilots.

There was a significant difference in “Aircraft acceptance before flight” scores for commercial flying (*M* =3.97, *SD*= 0.82) and recreational flying (*M*= 4.25, *SD* = 0.68) conditions; *t* (115) = -1.995, *p* = .048. These results suggest that the acceptance of an aircraft before flight is more associated with significant decision making by recreational pilots than commercial pilots.

One-way Analysis of Variance

A one-way ANOVA was conducted in order to compare mean rating scores provided to a number of items between several independent groups, clustered by age and flying hours.

<u>One-way analysis of variance for age groups.</u>

A one-way ANOVA was conducted for the question comparing the benefits of the availability of psychological services within the aviation companies on pilots having under 25 years of age, pilots between 25 to 50 years of age and pilots having more than 50 years of age. A significant effect of “Psychological services may be beneficial to pilots and should be made available by aviation companies” on different age groups was noted at the p <0.05 level for the three age groups [*F* (2, 112) = 3.409, *p* =.037]. Post hoc analyses using the Student-Newman-Keuls post hoc test indicated a significant difference between pilots having more than 50 years of age (*M* = 3.49) and pilots having under 25 years of age (*M* = 4.21). However, there was no significant difference noted between pilots having more than 50 years of age (*M* = 3.46) and pilots having between 25 to 50 years of age (*M* = 3.86). Furthermore, no significant difference was displayed between pilots in the age bracket of 25 to 50 years of age (*M* = 3.86) and pilots having under 25 years of age (*M* = 4.21). These results suggest that benefits regarding the availability of psychological services within the aviation companies impact age groups differently. Mostly acknowledged by pilots having under 25 years of age and least acknowledged by pilots having more than 50 years of age.

A one-way ANOVA was conducted for the question comparing the effect of “Time of day” on pilots having under 25 years of age, pilots between 25 to 50 years of age and pilots having more than 50 years of age. A significant effect of “Time of day” on different age groups was noted at the p <0.05 level for the three age groups [*F* (2,114) = 5.364, *p* = .027]. Analyses using the Student-Newman-Keuls post hoc test indicated a significant difference between pilots having more than 50 years of age (M= 3.04) and pilots having between 25 to 50 years of age (*M* = 3.70). However, no significant difference between pilots having more than 50 years of age (*M* = 3.04) and pilots having under 25 years of age (*M* = 3.43). Furthermore, no significant difference was displayed between pilots having under 25 years of age (*M* = 3.43) and pilots having between 25 to 50 years of age (*M* = 3.70). These results suggest that time of day impacts decision-making in age groups differently. Specifically, the impact of time of day on decision-making is greater in pilots having between 25 to 50 years of age and least on pilots having more than 50 years.

A one-way ANOVA was conducted for the question comparing the effect of “Aircraft acceptance before flight” on pilots having under 25 years of age, pilots between 25 to 50 years of age and pilots having more than 50 years of age. A significant effect of aircraft acceptance before flight on different age groups was noted at the p <0.05 level for the three age groups [*F* (2, 114) = 3.202, *p* = .044]. Using the LSD post hoc analysis for the comparison of pilots, indicated that pilots under 25 years of age and pilots having between 25 to 50 years of age, have a significance level of .187. Since this value is greater than the .05 level required for statistical significance, no significant difference was noted between these age groups. For pilots having under 25 years of age and pilots having more than 50 years of age, the level of significance is .770. Since this value is greater than the .05 level required for statistical significance, there was no significant difference noted between the two age groups. For pilots having between 25 to 50 years of age and pilots having more than 50 years of age, the level of significance is .016. Since this value is lower than the .05 level required for statistical significance, a significant difference was noted for these age groups. Results indicate that pilots having more than 50 years of age ($M = 4.28$) associate "Aircraft acceptance before flight" with significant decision-making, more than pilots having between 25 to 50 years of age ($M = 3.91$).

One-way analysis of variance for flying hours.

A one-way ANOVA was conducted for the question comparing the effect of "Macho" hazardous attitude on pilots having under 1000 flying hours, pilots between 1000 to 5000 flying hours and pilots having more than 5000 flying hours. A significant effect of macho hazardous attitude on different flying hours was noted at the $p < 0.05$ level for the three flying hours brackets [$F(2, 114) = 6.118$, $p = .003$]. Post hoc analyses using the Student-Newman-Keuls post hoc test, indicated no significant difference between pilots having under 1000 flying hours ($M = 4.52$) and pilots having between 1000 to 5000 flying hours ($M = 4.53$). However, a significant difference was noted between pilots having more than 5000 hours ($M = 3.88$) and pilots having under 1000 flying hours ($M = 4.52$). In addition to this, a significant difference was displayed between pilots having more than 5000 hours ($M = 3.88$) and pilots having between 1000 to 5000 flying hours ($M = 4.53$). These results suggest that macho hazardous attitude is considered hazardous by pilots with differing experience in flying hours rather differently. Specifically, the macho hazardous attitude is less acknowledged as hazardous by pilots having more than 5000 flying hours and mostly acknowledged as hazardous by pilots having between 1000 to 5000 flying hours.

A one-way ANOVA was conducted for the question comparing the effect of "Commercial pressures" on pilots having under 1000 flying hours, pilots between 1000 to 5000 flying hours and pilots having more than 5000 flying hours. A significant effect of "Commercial pressure" on different flying hours' brackets was noted at the $p < .05$ level for the three flying hours brackets [$F(2,114) = 8.319$, $p = < .001$]. Post hoc analyses using the Student-Newman-Keuls post hoc test indicated a significant difference was noted between pilots having more than 5000 flying hours ($M = 3.16$) and pilots having under 1000 flying hours ($M = 3.86$). In addition to this, another significant difference was displayed between pilots having more than 5000 flying hours ($M = 3.16$) and pilot having between 1000 to 5000 flying hours ($M = 3.91$). However, no significant difference was noted between pilots having under 1000 flying hours ($M = 3.86$) and pilots having between 1000 to 5000 flying hours ($M = 3.91$). These results suggest that decision- making is affected by "Commercial pressures" in pilots with differing amounts of flying hours rather differently. Specifically, "Commercial pressures" least affects decision-making in pilots having more than 5000 flying hours and mostly affects pilots having between 1000 to 5000 flying hours.

Mean Data for Decision-making During Different Flight Scenarios.

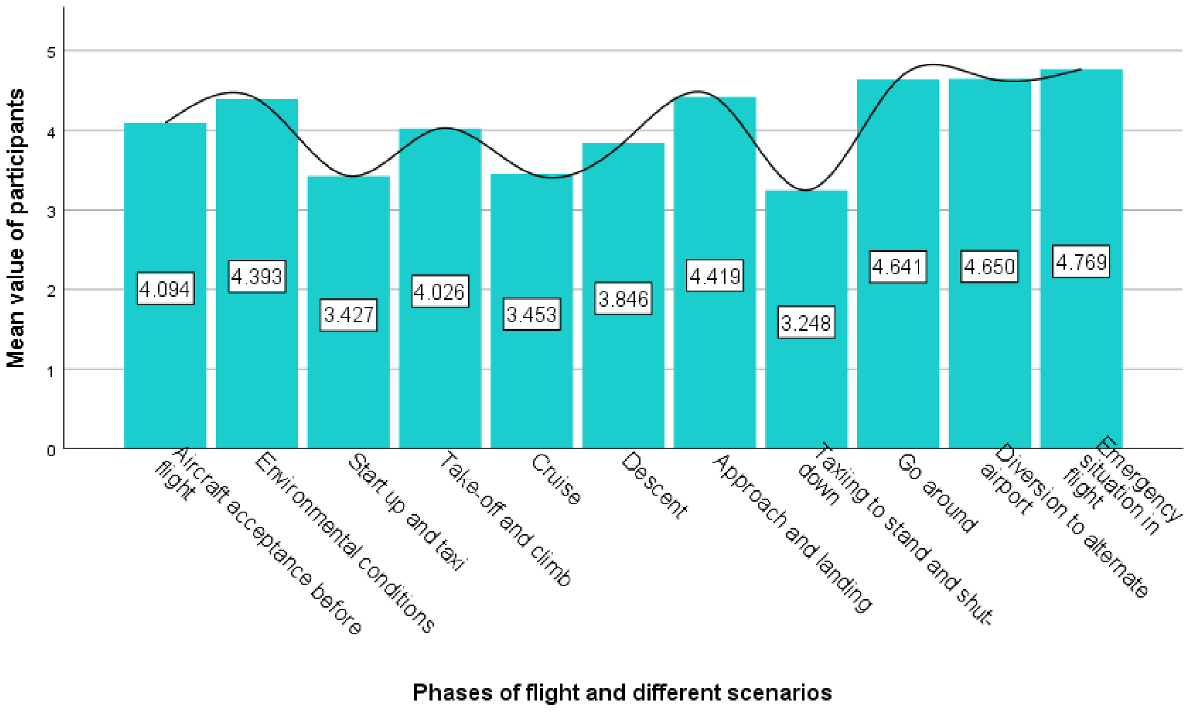

Figure 1 Mean data for respondents and different flight scenarios

Figure 1 displays the mean rating score for situations which involved significant decision-making for participants, during different phases of flight and three additional flight scenarios deviating from the original flight plan. The highest mean rating score for different phases of flight is noted during "Approach and landing" ($M = 4.42$), followed by "Take-off and climb" ($M = 4.03$), "Descent" ($M = 3.85$), "Cruise" ($M = 3.45$), "Start-up and taxi" ($M = 3.43$) and "Taxiing to stand and shut-down" ($M = 3.25$). The highest mean score for deviations from the original flight plan is noted during "Emergency situation in flight" ($M = 4.77$), followed by "Diversion to alternative airport" ($M = 4.65$) and "Go around" ($M = 4.64$).

Frequency Data.

Frequency data was gathered by means of a multiple response questionnaire item aimed at discovering which of the mentioned mnemonics models and checklists participants were familiar with. This item displayed the least overall participation, as only 64% of participants responded from the overall 117 respondents. Those who did not respond consisted of 29% of the commercial pilots and 45% of the recreational pilots.

Table question 9

Discussion

The Rejection of the Null Hypotheses between Commercial and Recreational Pilots

The preflight phase

Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was rejected for “Aircraft acceptance before flight” in the case of commercial and recreational flying. Specifically, results suggest that “Aircraft acceptance before flight” is more associated with significant decision making by recreational pilots than commercial pilots. This could possibly be due to additional assistance provided by other crew members, maintenance, operations and ground staff to pilot-in-command during the preflight phase. McElhatton & Drew (1993), indicated that the pre-flight phase is crucial, as certain pre-flight decisions led directly to accidents and incidents during later phases of the flight.

Underlying psychological aspects of health

During the medical examination, certain underlying psychological aspects of health are not particularly confronted (Lewis et al., 2006). In the questionnaire participants were asked if decision making is affected by “Personal issues” and the majority agreed with this statement. Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was rejected for the effect of “Personal issues” on ADM between commercial and recreational pilots. Specifically, results suggest that the impact of “Personal issues” on decision-making is greater for recreational pilots than for commercial pilots. Perhaps this could be due to financial pressures, as while commercial pilots fly to earn money, recreational pilots have to earn money so that they can fly.

Fatigue

Insufficient sleep, time of day, operating through several time zones, the workload and duration of the task at hand generate fatigue (FAA, 2012). Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was rejected for the influence of “Time of day” on ADM between commercial and recreational pilots. Results suggest that the impact of “Time of day” on decision-making is greater for commercial pilots than for recreational pilots. A reason for this could be that commercial pilots must abide to a given schedule, while recreational pilots have the flexibility to slot flights to their requirements.

Hazardous attitudes

Research identifies five hazardous attitudes that may hinder the decision making process (FAA, 2016). Five questions from the questionnaire focused on the five hazardous attitudes, to evaluate if they are considered hazardous towards ADM among participants. Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was rejected for “Macho” hazardous attitude, in the case of commercial and recreational flying. Specifically, results suggest that recreational pilots consider “Macho” hazardous attitude more hazardous than commercial pilots. This could be due to commercial pilots having an organizational setup controlling the “Macho” pilot, while recreational plots might not have such a setup, having less control over this attitude.

The Rejection of the Null Hypotheses between Different Age Groups

Pilot acceptance of an aircraft before flight

For "Aircraft acceptance before flight" through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was rejected in the case of different age groups. Results from the LSD post hoc test for different age groups indicated significant difference in pilots having between 25 to 50 years of age and pilots having more than 50 years of age. Specifically, pilots having more than 50 years of age associate "aircraft acceptance before flight" with significant decision-making, more than pilots having between 25 to 50 years of age. Pilots between 25 to 50 years are more likely to be employed with airlines, having the necessary staff assisting the pilot in command during preflight checks. Whilst pilots having more than 50 years of age might be employed with small scale companies or conducting recreational flights which do not have the same staff backup.

Time of day

Fatigue induced by time of day impacts pilot performance specifically during night time hours (FAA, 2012). Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was rejected for the influence of "Time of day" on ADM between pilots from different age group. Furthermore, analyses using the Student-Newman-Keuls post hoc test indicated that the influence of time of day on decision-making ADM is greater for pilots having between 25 to 50 years of age and least in pilots having more than 50 years. Pilots between the age of 25 to 50 years are pilots who are most likely to be in the process of completing hour building, thus, not entirely in a position to refuse the offered fight roster. On the contrary, pilots over 50 are possibly pilots occupying senior positions with airlines, having ground duties in addition to flying. In this case flying duties are reduced. In addition to this at this age one can find a number of retired pilots who fly for the pleasure of flying, thus choosing flight time as desired.

Psychological services in aviation

According to Lewis et al., (2006), inadequate mental health wellbeing in aviation operations is rather dangerous, as it can potentially affect the safety conduct of a flight, through the impact on ADM, situational awareness, and judgment. "Psychological services may be beneficial to pilots and should be made available by aviation companies", when participants were given this statement the majority agreed. Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was rejected for different age groups. Results using the Student-Newman-Keuls post hoc test illustrate that the benefit of psychological services within aviation, is mostly acknowledged by pilots having under 25 years of age and least acknowledged by pilots having more than 50 years of age. This could be a reflection of the mentality linked with different age brackets towards psychological services. Pilots fear that psychological services could be the means to suspend or revoke their pilot licence, thus, resulting in loss of employment, income for the commercial pilot and exhilaration for the recreational pilots.

The Rejection of the Null Hypotheses between Different Amounts of Flying Hours

Commercial pressures

The company's emphasis on efficiency, may unintentionally conflict with safety (Orasanu et al., 1998). According to Nance (1986), one aviation company compensated passengers 1 US

Dollar for each minute of delay, until one of its aircraft pressed on through bad weather and crashed. The literature reviewed, recognised that commercial pressures can influence the pilot decisions. When questionnaire respondents were asked if decision making is affected by "Commercial pressures" the majority of participants were in agreement. Through the use of the independent-samples *t*-test, one-way ANOVA and Student-Newman-Keuls post hoc test, the null hypothesis was rejected in the case of different flying hours. Specifically, "Commercial pressures" mostly affect the ADM in pilots having between 1000 to 5000 flying hours and least affects those having more than 5000 flying hours. Pilots having 1000 to 5000 flying are still in need of hour building and to establish themselves as pilot-in-command. At this level of experience job opportunities are limited and pilots have no other options but to endure organisational pressure. Experienced pilots have more employment opportunities, if commercial pressure becomes intolerable one could easily find employment with another organisation.

Macho attitude

Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was rejected for "Macho" hazardous attitude, in the case of different flying hours. Results for Student-Newman-Keuls post hoc test, indicated that "Macho" hazardous attitude, is less acknowledged as hazardous by pilots having more than 5000 flying hours and mostly acknowledged as hazardous by pilots having between 1000 to 5000 flying hours. Results possibly suggest that the greater the flying hours, the greater the control over "Macho" hazardous attitude.

The Acceptance of the Null Hypotheses for Commercial and Recreational, Different Age Groups and Different Amounts of Flying Hours.

From the questionnaire, no item resulted in the rejection of all three null hypotheses. Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was accepted in the case of different flying hours for the significance of ADM during "Aircraft acceptance before flight"; the impact of "Personal issues" on ADM in relation to age group and flying hours; the effect of "Time of day" on ADM in different amount of flying hours; the perspective of hazardous attitudes between different age groups; the effect of the availability of psychological services within the aviation companies for commercial and recreational pilots and different flying hours.

Decision-making aids

Several research studies have identified that decision-making training is highly effective at enhancing ADM (Buch & Diehl, 1984; Diehl, 1991; FAA, 2016). When questionnaire participants were asked if decision making is affected by the "Training received" the majority were in agreement with this statement. The independent-samples *t*-test and one-way ANOVA, indicated no significant difference in the perspective of "Training received" on ADM between commercial and recreational pilots, different age groups and different amounts of flying hours. Thus, the null hypotheses were accepted in all three cases.

According to Li and Harris (2001), programs aimed at training pilots in using ADM mnemonics, eventually attain significant increase in flight safety. In the questionnaire the multiple response item which focused on the familiarity of participants with mnemonics models and checklists displayed the least overall participation. From the overall 117 participants, only 64% of participants responded to being familiar with decision-making mnemonics and checklists. Those who did not respond to this question consisted of 29% of the commercial pilots and 45% of the recreational pilots. Thus, having such an abundant amount of participants who did not respond to this section, is rather upsetting. Perhaps this study highlighted an issue that needs to be evaluated further.

Pilot experience

According to Marrow et al., (2009) professionals generally surpass beginners on various decision-making tasks. Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was accepted for the effect of "Pilot experience" and "Pilots tend to conform with decisions made by other more experienced pilots in similar circumstances" on ADM. Thus, there was no difference in the perspective of ADM between commercial and recreational pilots, different age groups and different amounts of flying hours on ADM for pilot experience and the tendency for less experienced pilots to follow decisions taken by more experienced pilots. The mean for these two questions indicates that the majority of participants are in agreement with these statements.

Preflight phases and the analysis of environmental conditions help the pilot decide whether to go ahead with the flight or not. These procedures cannot be replaced by experience. The majority of participants agreed that "Environmental conditions" are associated with significant decision making by pilots. Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis was accepted for the association of "Environmental conditions" with significant decision-making. Thus, there was no difference in the perspective of ADM between commercial and recreational pilots, the different age groups and different amounts of flying hours for the significance of "Environmental conditions" with decision-making.

Crew-resource management

According to Jensen (1989), CRM is the extension of ADM from the pilot to the multiple person flight crew, with emphasis given to communication. Majority of respondents agreed that decision-making is affected by CRM. Through the use of the independent-samples *t*-test and one-way ANOVA the null hypothesis was accepted. There was no difference in the perspective of CRM and its effect on ADM for commercial and recreational pilots, different age groups and different flying hours.

Phases of flight

According to Airbus (2014), FAA (2016), Boeing (2016) and ICAO (2014), the majority of accidents occur during approach/landing or take-off/climb phases of the flight. This suggests that such phases, involve substantial decision-making necessary for the completion of a safe flight. Results from this research, confirm this statement as the highest mean rating score for different phases of flight was during "Approach and landing" and "Take-off and climb" respectively.

As for pilot capabilities and workload, literature showed that as workload increases the more are the pilot capabilities challenged (FAA, 2016). In addition to the phases of flight, the questionnaire included three flight scenarios which deviate from the original flight plan. "Emergency situation in flight", "Diversion to alternative airport" and "Go around" displayed a higher mean rating score than "Approach and landing" indicating that at each instance, workload challenges pilot capabilities more than the landing phase. When pilot capabilities are challenged, he or she could possibly fall into behavioural traps, such as “Mindset” and “Get-there-itis” mentioned in AC 60-22 (FAA, 1991).

Through the independent-samples *t*-test, use of one-way ANOVA, the null hypothesis was accepted during all phases of flight and the additional flight scenarios. Thus, there was no difference in the perspective of ADM between commercial and recreational pilots, the different age groups and different amounts of flying hours for flight phases, including the additional scenarios.

Hazardous Attitudes

Research shows five hazardous attitudes that may hinder the decision making process (FAA, 2016). Questions 10 to 14 of the questionnaire focused on the five hazardous attitudes to evaluate if they are considered hazardous towards ADM among participants. Through the use of the independent-samples *t*-test and one-way ANOVA, the null hypothesis is accepted for all hazardous attitudes except the “Macho” attitude. Thus, there was no difference in the perspective of *impulsivity*, *invulnerability*, *resignation*, *anti-authority* and their effect on ADM for commercial and recreational pilots, different age groups and different flying hours.

Conclusion

The research question for this study was to determine if there is a difference in the perspective of ADM between commercial and recreational pilots, pilots from different age groups and pilots having different amounts of flying hours. All three of the research questions were answered and discussed respectively. Thus, the aim of this research was achieved.

This study was not intended to be conclusive but rather to act as a catalyst for further research. During this research, various topics related to pilot decision-making were reviewed, each topic could be studied in isolation. Aviation is not something which is static but something that is always evolving. Thus, the cooperation of all stakeholders is crucial. In aviation one can never say that enough has been done.

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