

CRANFIELD UNIVERSITY

ANDRIES MARTHINUS ROOS

A COMPARATIVE ANALYSIS OF GENERAL AVIATION CRASH
DATA OF THE UNITED KINGDOM AND SOUTH AFRICA

SCHOOL OF AEROSPACE, TRANSPORT, AND
MANUFACTURING
Safety and Accident Investigation

MSc THESIS
Academic Year: 2019-2021

Supervisor: Dr Leigh Dunn
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the degree of Master of Science.

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ABSTRACT

Detailed aviation accident reports contribute invaluablely towards aviation safety, mainly by their safety recommendations. This study examines whether a data-driven, in-depth assessment and statistical analysis of these reports could highlight other ways to improve GA safety.

This mixed-methods research analysed 983 publicly available field investigation reports relating to GA accidents from the United Kingdom and South Africa. The data obtained provided insight into differences, correlations and adverse trends between the two countries. A survey questionnaire based on the data obtained was administered to GA pilots via social media to establish their perception of the data findings and GA safety. The survey results and the data analysis served as a guide to compile questions that were asked during interviews with GA pilots, maintenance engineers, flight instructors, and student pilots in order to examine areas of interest in more depth.

The results identified correlations in accident causation, training accidents and phase of flight. South Africa experienced significantly more occurrences linked to powerplant failures. Adverse trends were identified between the severity of injuries and pilot age, total flight experience and recent flight experience. Low recent flight experience and lower total time pilots experienced more severe injuries. Pilots aged 51 years and older are statistically more likely to experience fatal injuries in an accident; however, the regulator requires the same license revalidation criteria for pilots of all ages.

Keywords: Pilot Age, Flight Experience, Accident Causation, Flight Training, Accident Report Analysis.

TABLE OF CONTENTS

ABSTRACT	1
LIST OF FIGURES	4
LIST OF TABLES	5
LIST OF ABBREVIATIONS	6
1 Introduction.....	8
1.1 General	9
1.2 Research Purpose	9
2 Literature Review.....	11
2.1 Age	11
2.2 Experience.....	13
2.3 Accident Causation.....	15
2.4 Training.....	16
2.5 Context for Study	17
3 Methodology	18
3.1 Research Design	18
3.2 Data Collection Techniques.....	18
3.3 Measurements	20
3.4 Reliability and Validity.....	21
3.4.1 Accident causation.....	21
3.4.2 Pilot flight time.....	22
3.4.3 Phase of flight	23
3.4.4 Population age distribution and total flight time	23
3.5 Data Analysis Tools	23
4 Findings	25
4.1 Age	25
4.2 Experience.....	29
4.3 Accident Causation.....	36
4.4 Training.....	44
5 Discussion	49
5.1 Age	49
5.2 Experience.....	51

5.3 Accident Causation.....	52
5.4 Training.....	53
6 Conclusion.....	54
7 Acknowledgements	55
REFERENCES	56

LIST OF FIGURES

Figure 1 Crystallized and fluid abilities versus age. Zero line represents the mean or average performance (Murman, 2015).....	11
Figure 2 Distribution of age for UK pilots compared to Taylor's (2014) survey age.	13
Figure 3 Number of ERCS Risk occurrences for small non-commercially operated aircraft by safety issue, 2015-2018 (EASA, 2019).....	16
Figure 4 Age distribution of SA accident pilots	27
Figure 5 Age distribution of UK accident pilots.....	27
Figure 6 Distribution of pilot TT and injury severity	33
Figure 7 Analysis of the TT90 data and severity of injuries.....	35
Figure 8 Severity of Injuries per CICTT category.	38
Figure 9 CICTT occurrences per Injury Category.....	39
Figure 10 Injuries per aircraft type.....	40
Figure 11 Injuries per Country	40
Figure 12 CICTT categories per country	41
Figure 13 License type per Injury Category.....	45

LIST OF TABLES

Table 1 Hypothesis Test Summary	25
Table 2 UK data of age groups and injuries	26
Table 3 SA data of age groups and injuries	26
Table 4 SA and UK combined data of age groups and injuries.....	28
Table 5 Experience hypothesis test of the UK data.....	30
Table 6 Experience hypothesis test of SA data.....	30
Table 7 Experience hypothesis test of combined data of SA and the UK	31
Table 8 Cross-tabulation of the TT data: Injuries	32
Table 9 Country cross-tabulation of the TT data per country	34
Table 10 TT90 below 10 hours and age groups cross-tabulation	35
Table 11 CICTT and age groups cross-tabulation.....	37
Table 12 CICTT and phase of flight cross-tabulation	43
Table 13 Training injuries and license cross-tabulation.....	44
Table 14 Phase of flight and injuries cross-tabulation	46
Table 15 Country and Type Crosstabulation	48

LIST OF ABBREVIATIONS

AAIB	Air Accidents Investigation Branch
AME	Aviation Medical Examiner
ARC	Abnormal Runway Contact
CAA	Civil Aviation Authority
CAST	Commercial Aviation Safety Team
CFI	Chief Flight Instructor
CFIT	Control Flight into Terrain
CTOL	Collision with Obstacle during Take-Off or Landing
CICTT	CAST/ICAO Common Taxonomy Team
CRI	Class Rating Instructor
DAME	Designated Aviation Medical Examiners
EASA	European Aviation Safety Agency
ERCS	European Risk Classification Scheme
FAA	Federal Aviation Administration
FI	Flight Instructor
F-NI	Fire/Smoke (Non-Impact)
GA	General Aviation
GCOL	Ground Collision
ICAO	International Civil Aviation Organization
IMC	Instrument Meteorological Conditions
IRR	Inter-Rater Reliability
LALT	Low Altitude Operations

LOC- G	Loss of Control – Ground
LOC-I	Loss of Control In-flight
MAC	Mid-Air Collision
NPL	National Private Pilot's Licence
NTSB	National Transport and Safety Board
PIC	Pilot In Command
PPL	Private Pilot's Licence
RE	Runway Excursions
SA	South Africa
SACAA	South African Civil Aviation Authority
SCM	Swiss Cheese Model
SCF-NP	System/Component Failure/Malfunction – Non Powerplant
SCF-PP	System/Component Failure - Powerplant
SD	Spatial Disorientation
SPL	Student Pilot License
TT	Total Flight Hours (Total Time)
TTToT	Total Time on Type
UK	United Kingdom
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

1 Introduction

It is often said that there are three classes of aviation: military, airlines, and everybody else. Everybody else is better known as general aviation, and on any given flying day, it might include flight training, pleasure flying, police and sheriff air patrol, aerial firefighting, aerial burial, crop dusting, and so on. (Casner, 2010)

This thesis deals with General Aviation (GA) which is a broad and diverse sector that operates a wide range of aircraft types. Because of its diversity and rapid changes, the definition of GA is inconsistent across the world. The International Civil Aviation Organisation (ICAO) defines GA as “*all civil aviation operations other than scheduled air services and non-scheduled air transport operations for remuneration or hire*” (ICAO, 2009, p. B.2). This definition, however, excludes flying schools and parachuting. The United Kingdom (UK) Civil Aviation Authority (CAA) defines GA as

all civil aviation operations other than scheduled air services and non-scheduled passenger or cargo flights. GA aircraft range from gliders, to microlights, to helicopters, to corporate business jets. GA covers a large range of activities both commercial and non-commercial, including flying clubs, flight training, agricultural aviation, light aircraft manufacturing and maintenance. (UK CAA, 2015, p. IA3)

This definition is very broad and includes a number of commercial aviation operations. If this definition were used, the data from the crash reports would have been substantial and beyond the scope of this research project. Therefore, to limit the data and focus on a specific area in this thesis, the following definition of GA was used:

Aviation activities that do not involve commercial gain, best described as recreational flying. However, it includes aircraft operations connected to flying school activities. GA aircraft are defined as aircraft below the gross mass of 5700 kg, including gliders (motorised and non-motorised), helicopters, gyrocopters and microlights.

1.1 General

Despite being a relatively narrow field, aviation is still extensively researched on an ongoing basis. Aviation accidents have received particular attention from researchers. Although GA accidents represent the majority of all aviation accidents, commercial aviation largely remains the chosen area for aviation research.

Ongoing research, advances in technology and flight crew training have reduced the accident rate for scheduled commercial flights to as low as 2.4 accidents per million departures and fatality rate to 12.2 fatalities per billion passengers (ICAO, 2018). The same cannot be stated for GA, which accounts for 94% of all air transport-related accidents in the United States (Shao, Guindani and Boyd, 2014; Walton and Politano, 2016); across Europe, the trend is similar (European Aviation Safety Agency, 2019). Moreover, unlike commercial aviation, detailed GA accident statistics are not as readily available. There also appears to be no global set of standards on accident reporting. Therefore, there are significant differences in how the various official investigating bodies compile accident reports.

1.2 Research Purpose

This thesis is a data-driven exploration of publicly available air accident reports from two countries: one in the northern hemisphere, the United Kingdom (UK, n=493) and one in the southern hemisphere, South Africa (SA, n=490). An approximately equal number of field crash investigation reports from each country were assessed to extract the following:

- Age of pilot
- Licence type
- Flying experience of pilot: total experience and hours flown in the previous 90 and 28 days before the accident
- Type of flight
- Type of aircraft
- Stage of flight

- Accident causation classed using CAST/ICAO Common Taxonomy Team (CICCTT) categories (ICAO and CAST, 2013).

1.3 Research Aim

The aim of this thesis was to contribute to GA safety by analysing accident reports from two different countries in order to identify trends, correlations and differences in the data.

1.4 Research Question

Can a data-driven, in-depth assessment and statistical analysis of accident reports contribute to GA safety beyond the safety recommendations already made in such reports?

1.5 Research Objectives

The objectives of this thesis were as follows:

- To undertake a literature review on the impact of age, experience, accident causation and training on GA safety.
- To compare the UK and SA accident and incident data.
- To categorise and analyse accident causation, stage of flight, license types and aircraft type.
- To determine the impact of pilot age, experience, accident causation, training and currency on GA safety.
- To identify trends relating to the impact of pilot age, experience and currency on the severity of accident injuries.
- To examine and compare findings arising from a GA survey and semi-structured interviews with GA pilots, instructors and aircraft maintenance engineers to accident data.

2 Literature Review

The aviation field possesses an exceptionally high level of safety. It is a complex field with a high density of organizations and agencies interacting in it. These various agencies, organizations, safety bodies, investigation agencies and academic researchers all play a vital role in the constant improvement of aviation safety. A detailed literature review on the key themes was done to determine the impact of age, experience, accident causation and training on GA safety.

2.1 Age

The relationship between age and pilot safety has been a research topic for years. Researchers found that increased age is associated with lower levels of cognitive performance, even in ranges from 18 to 60 years (Salthouse, 2009). Although vocabulary improves with age and remains stable into advanced age, processing speed declines and starts to affect performance above the age of 53 years (Figure 1; Murman, 2015).

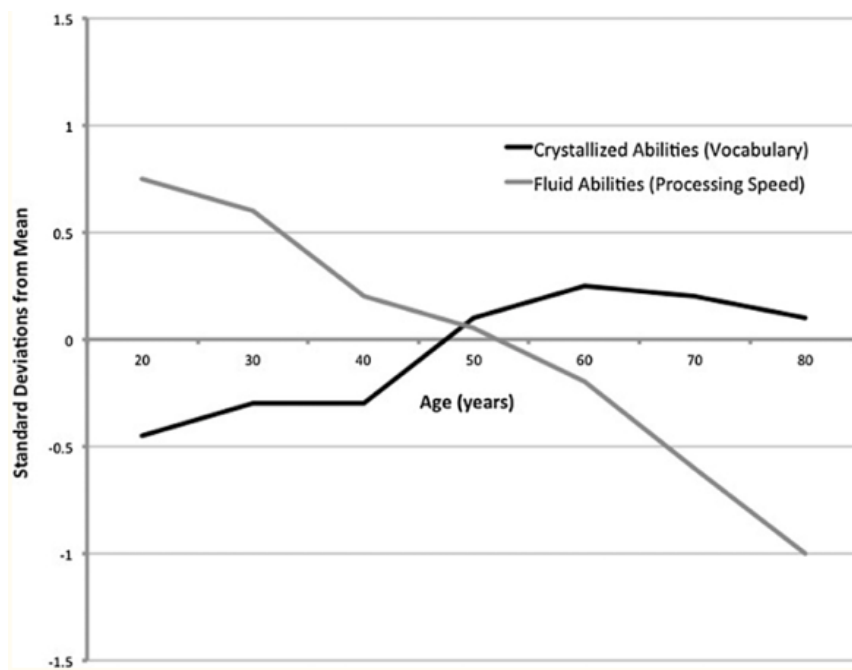


Figure 1 Crystallized and fluid abilities versus age. Zero line represents the mean or average performance (Murman, 2015).

Pilot processing speed is a vital aspect of handling dynamic emergencies. Evidence exists that male pilots over the age of 60 years are more likely to be involved in fatal accidents (Bazargan and Guzhva, 2011). In commercial aviation, the “Age 60 Rule” was enforced by the Federal Aviation Administration (FAA) since 1959. This regulation prohibits any pilot aged over 60 years from engaging in operations conducted under part 121 (24 FR 9767, December 5, 1959). Later, the “Fair Treatment for Experienced Pilots Act” has revised this rule and raised the retirement age to 65 years. This amendment, however, mandates that the other pilot’s age should not attain 60 years of age in international flights. While there is clear evidence of age-related cognitive decline, there is a debate over the age–safety relationship. For example, while Harkey (1996) revealed that pilots aged 40–44 years have a significantly higher accident rate than pilots aged 35–39 years, Broach (1999) reported that pilots aged 50–59 do not appear to have a significantly increased accident rate than pilots aged 40–49. Pilots above 60 years on average perform worse on dual-tasking tests, especially when the task requires high attention and precise control (Kennedy et al., 2010). Most aviation studies asserted that older pilots are more likely to be involved in fatal accidents; the ratio is unusually high for pilots above 60 (Bazargan and Guzhva, 2011). Supported by cognitive research findings, it could be deduced that pilots older than 60 years are less likely to deal with a dynamic in-flight emergency successfully.

Another important aspect to consider is the impact of age on the ability of the human body to survive physical trauma. Talving et al. (2010), in their study on motorcycle accident victims, found that older patients are significantly more likely to suffer severe trauma, head and chest injuries (Injury Severity Score >15). Patients were divided into 3 age groups: 18 years or younger, 19–55 years, and older than 55 years. The incidence of severe injury in the three ascending groups was 23.5%, 30.3% and 36.2%, respectively (Talving et al., 2010).

Demetriades et al. (2004) conducted a study on pedestrians injured by automobiles and found that the risk of death for the age groups 14 years and

younger, 15 to 55 years, 56 to 65 years and above 65 years to be 3.2%, 5.8%, 14.3% and 25.1%, respectively.

Interestingly, pilot gender and type of aircraft were found to be not significantly associated with the likelihood of survival in a crash (Li and Baker, 1999). Accordingly, it is also important to explore the age distribution of the GA pilot population in the UK, which was found to be the greatest between ages of 41 to 61 years, as shown in Figure 2 (Taylor, 2014). It could be argued that the data is inaccurate as it aligns with the GA population age distribution. Therefore, data of higher importance would be the ratio between fatal and total accidents in different age groups.

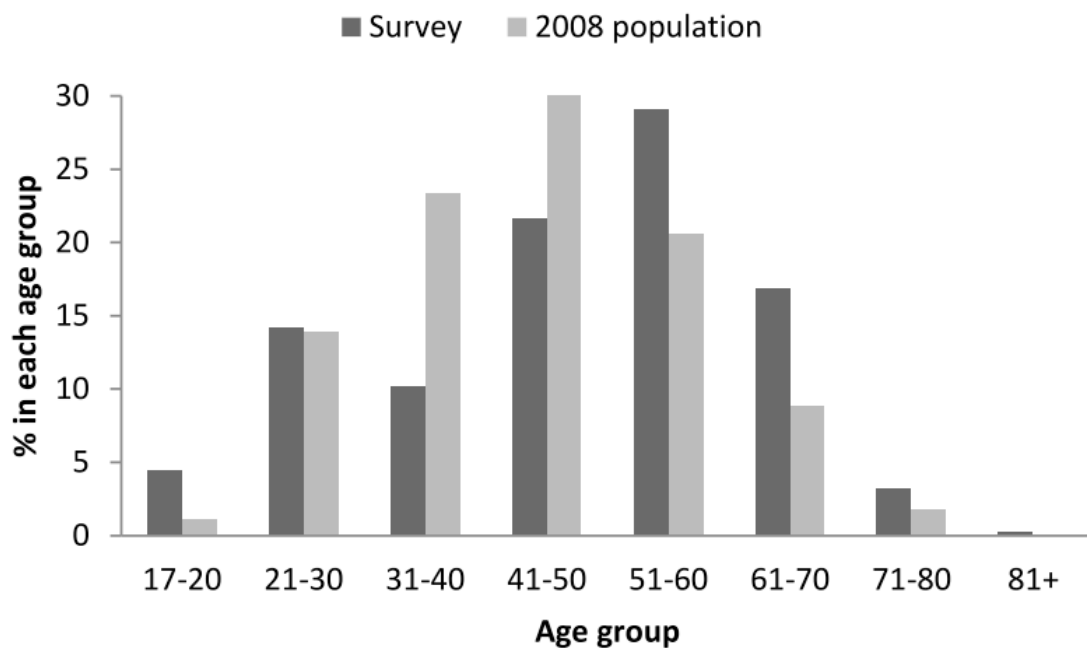


Figure 2 Distribution of age for UK pilots compared to Taylor's (2014) survey age.

2.2 Experience

In aviation, the term “experience” refers to the number of flight hours a pilot has accumulated, not the number of years of service in the industry. Experience is typically divided into Total Flight Hours (TT), Total Flight Hours on a Specific Aircraft Type (TTToT) and currency (sometimes referred to as recency). Currency is the number of hours that a pilot has flown in the last 90 (TT90) and 28 days

(TT28) preceding the accident. In commercial aviation, it is not uncommon to find pilots with experience of up to 25,000 TT. Further, as there is a significant cost implication in gaining experience in GA (Taylor, 2014), TT correlates with pilot age. Although there is a consensus that experience helps protect from accidents, the protective effect of flight experience reaches a plateau after 10,000 TT (Li et al., 2003).

While most researchers implicitly assume that accident rates are linearly related to TT, Craig (2001) reported that the relationship may be nonlinear. Craig (2001) presented evidence that at TT range of 50–350, GA pilots are at the highest risk and fatalities occur most frequently. Craig (2001) hypothesised that this could be due to pilots becoming overconfident yet lack flight skills and airmanship to handle their aircraft safely. Later research has cast doubt on the work of Craig (2001); Knecht (2013) found that relatively high risks for a GA pilot could extend well beyond 2000 TT. Accident frequency used by Craig (2001) could be explained simply by the fact that the number of GA pilots tends to decrease as TT increases (Knecht, 2013).

More experienced (TT) pilots tend to avoid the risky situation of flying into bad weather (Drinkwater and Molesworth, 2010). However, Drinkwater and Molesworth (2010) found that the traditional measures of pilot competence (i.e., TT, Recency and Age) do not display a relationship with pilot risk minimisation. This attitude relates to the pilot risk decision making and not the pilots' ability to deal with an emergency.

Flight currency can be viewed as a measure of pilot proficiency: The more the pilot flies in a given period, the more familiar he would be with the aircraft and its various systems. It could be expected that pilots with more recent flight time would have a lower accident rate than pilots with less currency. Proficient pilots are considered more likely to deal with emergencies successfully; therefore, the accident rate, for all ages, decreases as currency increases (Golaszewski, 1983). Golaszewski (1983) also found that with very low currency (below 50 hours per year), the accident rate generally increases with the age of the pilot.

Little credible research exists on the effect of TToT on GA safety. Pagán and De Voogt (2008) found that pilots with less than 40 hours experience in the same make and model gyroplane are five times more likely to be involved in an accident and four times more likely to involve fatalities. It was also found that 83% of pilot-related accidents in Ireland have less than 100 hours of experience in the type of aircraft involved (Owens, 2018). Pilots who lost control of their aircraft during the take-off phase were found to have significantly less experience on type than the rest of the survey pilots (Taylor, 2014).

2.3 Accident Causation

The ICAO and CAST jointly chartered the CICTT to develop standard taxonomies and definitions for aviation accidents and incidents (ICAO and CAST, 2013). CICTT taxonomies for accident causation are used in this thesis unless otherwise stated.

In an assessment of GA safety in Ireland, Owens (2018) found that Loss of Control in Flight (LOC-I) is the most common occurrence, followed by Runway Excursions (RE) and Abnormal Runway Contact (ARC), over the ten years of the study. LOC-I was also found to be the most significant cause of accidents in the UK, with LOC-I during the take-off phase most common, followed by Go-Around and lastly during the landing phase (Taylor, 2014). Based on the NTSB database, Branham (2013) showed that 73% of GA accidents contain the error of failing to maintain airspeed, with 50% of the accidents ending up in an aerodynamic stall/spin, which could also be classified as LOC-I.

The European Aviation Safety Agency (EASA) developed the risk classification scheme (ERCS) to present a more accurate view of aviation risk. ERCS is used to risk-classify all reported occurrences. Figure 3 shows that the two highest-risk categories are stall/spin and loss of control; both would be classified as LOC-I by CICTT taxonomy.

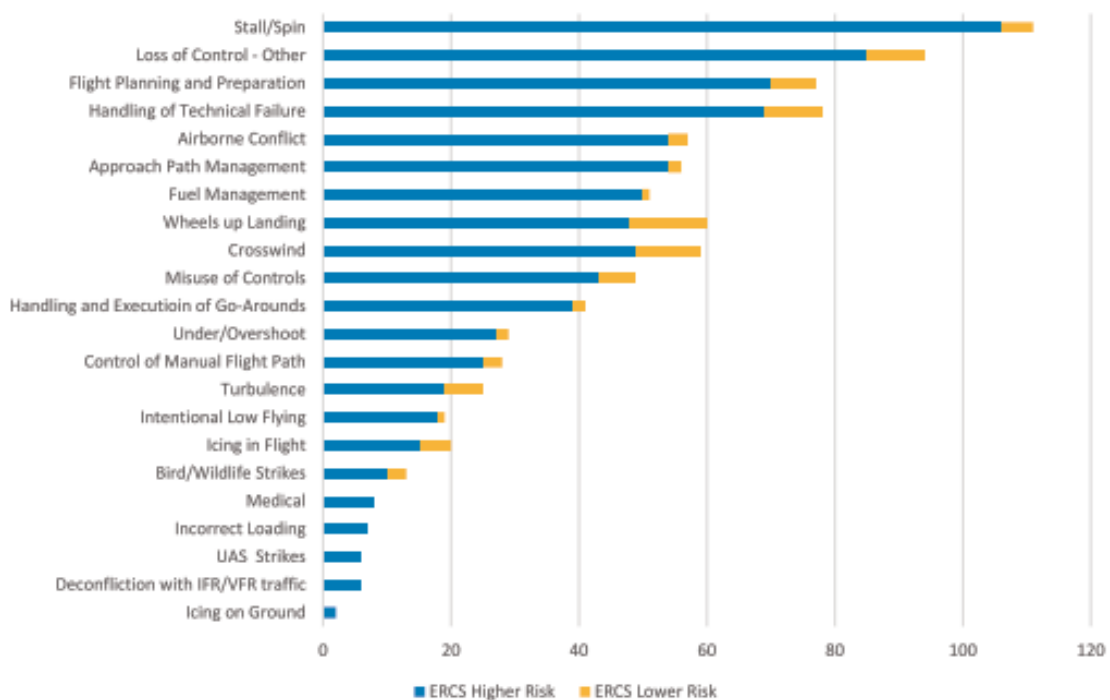


Figure 3 Number of ERCS Risk occurrences for small non-commercially operated aircraft by safety issue, 2015-2018 (EASA, 2019).

There are many contributing and aggravating factors in each accident. Although the final CICTT causal factor might state one cause, it is essential to keep in mind the factors leading up to the final causal factor; many crash reports state LOC-I. Only after studying the report in greater detail, other factors emerge, such as inadvertent Visual Flight Rules (VFR) into Instrument Meteorological Conditions (IMC), Spatial Disorientation (SD), human factors and even pilot fatigue (Crider, 2014). *“Pilots, aircraft and systems are deeply related in LOC-I accidents, but current definitions tend to examine these in isolation and not as a human-in-the-loop system”* (Macedo, Bidinotto and Bromfield, 2020).

2.4 Training

Current literature and various reports from credible aviation bodies confirm that aircraft loss of control is a substantial concern in GA. LOC accidents generally start due to several factors and ends in an uncontrollable spin (also referred to as a spiral dive) until impact.

In the UK, spinning is no longer part of the National Private Pilot's Licence (NPL) syllabus as it is considered too dangerous. As spin is a stall that has fully developed, stall recovery remains in the syllabus with the hope that it would be adequate to prevent LOC accidents. Stall recovery is also taught at high altitudes, generally at least 3000 ft above ground although the majority of LOC accidents happen during the take-off or landing phase, which would be at a much lower altitude (Taylor, 2014). The lack of sufficient aircraft upset recovery and speed awareness training has been cited as a cause for the high occurrence of LOC-I (Boatman, 2019). The hypothesis is that pilots are not sufficiently trained in speed awareness, which leads to aerodynamic stalls. By solving the airspeed awareness problem, 70–80% of all GA LOC-I fatal accidents could be preventable (Branham, 2013).

2.5 Context for Study

The literature review in this thesis sheds light on a number of main GA safety themes of age, pilot flight experience, accident causation and training. Despite this growing body of research, the situation is not improving. For example, the number of GA fatalities in the EU increased by 33% from 2017 to 2018 (EASA, 2019).

3 Methodology

3.1 Research Design

A multi-strategy (mixed methods) research design with a sequential explanatory structure was employed because of the substantial body of quantitative and qualitative data collected for this thesis (McCartan and Robson, 2016). This approach allows for the use of qualitative results to explain and interpret the findings of quantitative data and provides a definitive account of how the research data relate to each other.

Ethics approval for this thesis was obtained from the Cranfield University Research Ethics System (CURES). The research was deemed “*Low Risk, Level 2b*”. All surveys and interviews were done ethically and anonymised.

3.2 Data Collection Techniques

To obtain sufficient information, a detailed review was conducted on publicly available Air Accidents Investigation Branch (AAIB) accident and incident investigation reports as published on its website. The following filter criteria were applied on the website to obtain GA reports:

- Aircraft category: General Aviation – Fixed-Wing, General Aviation – Rotorcraft, Sport Aviation and Balloons
- Report type: Bulletin – Field investigation
- Date: 01/01/1999 – 31/12/2019 (240 Months)

The filter criteria yielded 558 reports. For this thesis, balloon, parachutists, paragliders and paramotors were discarded due to their different flight characteristics. Any military aircraft accidents were also excluded as they fall beyond the scope of this thesis. The final report count came to 493 reports.

Similar accident reports with the same filter criteria were obtained from the publicly available South African Civil Aviation Authority (SACAA) website for the following period: 01/08/2007–30/11/2018 (136 Months).

A total of 490 reports were obtained. The year 2019 was intentionally excluded as the SACAA has changed the format of their accident reports and information vital to this research (e.g. time on type and time in the last 90 days are no longer included in the reports). The time period was also selected in order to get a near equal number of reports from both countries.

The AAIB and SACAA reports were chosen as they both kept the format of their reports consistent and were the only two national aviation authorities which consistently reported “time on type” and “time in last 90 days” before the occurrence in their reports. Total time on type and total time in the 90 days prior to the occurrence are significant for this thesis since determining the role that experience and currency play in GA safety is one of the primary research objectives. To fulfil this objective, a survey questionnaire was designed and published on GA specific social media groups. The survey yielded 54 responses from both SA and the UK. The survey, unfortunately, failed in its primary design objective and the decision was made to discard the survey; however, in isolation, a few of the questions and responses proved to be valuable and were included in this thesis. All participants anonymously participated in the survey and gave consent to the terms and conditions of the survey.

The data of the accident report analysis was analysed using SPSS software and various stacked bar charts, scatter plots and descriptive statistics were exported to a folder. The data folder was included in semi-structured interviews with the following interviewees: four student pilots, four flight instructors, two aircraft maintenance engineers and two commercial pilots. The four student pilots were chosen as they represented low time ab-initio pilots and their perception and understanding of the data were of importance. The four flight instructors were selected to specifically represent the training theme. As the SA data indicated a significantly higher occurrence of SCF-PP than the UK, the two maintenance engineers were chosen to discuss the data. The two commercial pilots were chosen as they had significantly more experience as the GA pilots and how they perceived GA safety proved to be very valuable. One limitation is that all but one of the interviewees were South African. More UK interviewees would have been

beneficial and a better representation of the research population. Direct interpretation was used as a method to interpret the interviews. All interviews were recorded with the permission of the interviewees.

3.3 Measurements

From the accident and incident reports, the following data was extracted for further analysis:

- Type of flight
- Age of pilot
- Injuries
- Licence of pilot
- Aircraft type
- Phase of flights
- Occurrence Causation category
- Total time of pilot
- Total time on occurrence aircraft type
- Total flight time in the 90 days preceding the occurrence
- Total flight time in the 28 days preceding the occurrence (AAIB only).

The type of flight was classified as either private or training. Training occurrences might include the presence of an instructor on board. Injuries were grouped according to the most severe injury in the occurrence. The most severe injury might be a passenger or the pilot. The phase of flight was classified per the EASA annual safety review (EASA, 2019). The occurrence categories used were as per the CICTT. The need was identified by ICAO in order to create a common taxonomy to aid various member states in reporting and investigating occurrences. A common taxonomy creates uniformity and eliminates possible ambiguity in occurrence causation reporting. CICTT, therefore, created the aviation occurrence categories taxonomy (ICAO and CAST, 2013) which is now widely used throughout the aviation industry, especially in safety publication and accident and incident reporting.

The survey design relied heavily on an emergency scenario to compare the participants' answers with pilot age, currency, total time and pilots' perception of their abilities. The scenario (Question 7 in the survey) was modelled from the Old Hazardous Attitude Scale (Old-HAS) where the scenario depicted an aviation situation that calls for a timely decision on the part of the pilot (Hunter, 2005). The scenario was a low-level (300ft) engine failure after take-off. The scenario failed because it relied on the participants' flight experience in the 28 and 90 days prior to completing the exercise. Because of the 2020 COVID-19 pandemic, all participants had almost no flight hours in the preceding 90 days before the simulation. This made it impossible to correlate the participants answers to their TT28 and TT90.

In isolation, survey questions about participants' knowledge of speed awareness and upset recovery, age, total experience and knowledge of accident causation proved to be valuable enough to include in the findings.

The semi-structured interviews focused on the interviewees' interpretation of the data. The interview questions were derived from the research findings; they were aimed to establish the interviewees' perspective and knowledge of the findings. An interview plan was drawn up and used as a guide in all interviews (Appendix 6). Free narrative was encouraged to allow room for the interviewees to express themselves freely. The interviewees were also introduced to the Dunning–Kruger effect (Kruger and Dunning, 1999) and asked to elaborate on the prevalence of the effect in GA. The average interview time was around 60 minutes. Since the majority of interviewees were South African, the results cannot be generalized and UK interviews would be recommended to expand on this research.

3.4 Reliability and Validity

This thesis has few potential limitations. The identified concerns are as follows:

3.4.1 Accident causation

Several factors play a role in each accident or incident: causal factors, contributing factors and aggravating factors. Often more than one factor could be a causal factor. The well-know “swiss cheese model” illustrates this point clearly,

with each cheese layer being a safety barrier that eventually fails and becomes one of the factors (Reason, 1990). The data in this thesis only assigned one causal factor per accident/incident as coded from the accident investigation reports. Therefore, additional causal, contributing and aggravating factors were omitted, mostly by the crash investigators who compiled the reports.

The following example was extracted from the findings section of an AAIB report: *“Control was lost after the helicopter entered an area of poor weather conditions, during which the pilots were probably unable to maintain VMC”* (Air Accidents Investigation Branch, 2008). The phrase “control was lost” was qualitatively coded as LOC-I. However, the pilot flew into bad weather and impacted terrain. The causal factor could also be recorded as inadvertent visual flight rules flying into instrument meteorological conditions (VFR into IMC), SD, loss of situational awareness or lastly, as it was recorded, *“control was lost”* thus LOC-I. The primary causal factor seems to be at the discretion of the accident report writer, thereby creating a possible misrepresentation of the facts and complicating accurate research. Direct interpretation was used to distinguish between causal factors, contributing factors and aggravating factors. The research would benefit from an inter-rater reliability (IRR) test (McDonald, Schoenebeck and Forte, 2019) as there was some ambiguity in the accident reports with relation to causation. Other researchers might, therefore, code the primary causal factors differently.

The mixed-methods research design allowed for methodological triangulation (Turner and Turner, 2017) as a validity checking method since the interview plan and survey questions were based upon the qualitative and quantitative data obtained from the reports.

3.4.2 Pilot flight time

Pilots often carry their paper-based logbooks in their flight bags with them inside the aircraft. Many accidents involve a post-impact fire, which leads to the total destruction of this valuable document. The investigators are then forced to calculate hours flown based on hours declared on the pilots' last flight medical reports, which are mostly self-declared and not verified. To cover the period between the last medical and the occurrence, investigators make use of available

fuel uptake records. Fuel uptake could have happened at various airports or even at small, unregistered airfields which again would make accurate flight hour calculations difficult. Field investigators generally have a high workload and might not consider the accuracy of flight experience records as a high priority. It is, therefore, safer to assume that there is a margin of error in flight experience as recorded in occurrence reports.

3.4.3 Phase of flight

Because neither country officially records the phase of flight in the report templates, it was coded from the report synopsis. For example, the following was stated in one AAIB report: *“The aircraft departed from this site but failed to arrive at the intended destination near Lockerbie”* (Air Accidents Investigation Branch, 2008). In this example, the phase of flight was recorded as *“En-route”*; however, it is entirely possible that the pilot crashed while attempting to land, be it an emergency or precautionary landing, which would have been a different stage of flight. Stage of flight proved easier to code than accident causation as there appeared to be less ambiguity in the accident reports. An IRR test would improve the reliability of the phase of flight data. Methodological triangulation assisted in phase of flight validity checking.

3.4.4 Population age distribution and total flight time

The cost associated with GA plays a significant role in the age and total time of GA pilots (Taylor, 2014). Therefore, older pilots have more flight time and younger pilots have less flight time. It is very rare to find a young pilot with a high total flight time. The relation between age and flight time might impact the findings, although less in currency experience.

3.5 Data Analysis Tools

IBM SPSS (version 26) was used for the analysis of quantitative data obtained from the reports. Non-parametric tests (independent-samples Kruskal-Wallis test), descriptive statistics, scatter plots and stacked bar charts proved most valuable. Qualtrics survey software’s report producing functionality was used.

Interview results were recorded on audio with permission from the interviewees and the results were grouped together on Microsoft Excel.

4 Results

The quantitative data obtained from the accident reports together with the qualitative data from the survey and interviews led to the following findings.

4.1 Age

Age was the only data extracted from the accident reports that followed the normal distribution curve, although the data from SA were only bimodal. The objective was to establish the impact of age on the injuries sustained during accidents and to determine the correlation between accidents and age of the pilot. The hypothesis test revealed a significant correlation between age and injuries. The distribution of age was not the same across the categories of injuries and the null hypothesis was rejected (Table 1).

Table 1 Hypothesis Test Summary

<i>Hypothesis Test Summary</i>				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Age is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Note. Asymptotic significances are displayed. The significance level is .050.

When cross-tabulation was performed with UK data, SA data and lastly the combined data of both countries, trends emerged among the age groups of the pilots and the seriousness of the injuries. Between the <20 age group and the 41–50 age group, most accidents tended to involve minor injuries (none/minor injuries <20=50%, 21–30=50%, 31–40=45.3%, 41–50=46.4%). From the 61–70 age group to the >80 age group, most accidents were fatal accidents (61–70=50%, 71–80=67%, >80=67%). The 51–60 age group seemed to be a transition age where fatalities became more than none/minor injuries (Table 2).

Table 2 UK data of age groups and injuries*Age Groups * Injuries Crosstabulation*

		Injuries			Total
		None/Minor	Serious	Fatal	
Age Groups	<20	Count	2	1	4
		% within Age Groups	50.0%	25.0%	100.0%
	21-30	Count	13	11	26
		% within Age Groups	50.0%	42.3%	100.0%
	31-40	Count	24	24	53
		% within Age Groups	45.3%	45.3%	100.0%
	41-50	Count	58	53	125
		% within Age Groups	46.4%	42.4%	100.0%
	51-60	Count	56	70	149
		% within Age Groups	37.6%	47.0%	100.0%
	61-70	Count	30	21	101
		% within Age Groups	29.7%	20.8%	100.0%
	71-80	Count	7	3	30
		% within Age Groups	23.3%	10.0%	100.0%
	> 80	Count	0	1	3
		% within Age Groups	0.0%	33.3%	100.0%
Total		Count	190	70	491
		% within Age Groups	38.7%	14.3%	100.0%

SA data demonstrated a similar pattern with 81.3% of pilots below 20 years of age only suffered none/minor injuries (Table 3). The percentage then gradually decreased till the 51–60 age group when the percentage fatalities surpassed the percentage of none/minor injuries. However, from the 61-80 age group, the percentage fatalities fell below the percentage of none/minor injuries. There were also no accidents in the SA data sample of pilots above the age of 80 years and only three accidents above 70 years of age (Table 3).

Table 3 SA data of age groups and injuries*AgeGroups * Injuries Crosstabulation*

		Injuries			Total
		None/Minor	Serious	Fatal	
AgeGroups	<20	Count	13	1	16
		% within AgeGroups	81.3%	6.3%	100.0%
	21-30	Count	64	23	94
		% within AgeGroups	68.1%	24.5%	100.0%
	31-40	Count	49	23	85
		% within AgeGroups	57.6%	27.1%	100.0%
	41-50	Count	75	35	130
		% within AgeGroups	57.7%	26.9%	100.0%
	51-60	Count	48	22	119
		% within AgeGroups	40.3%	18.5%	100.0%
	61-70	Count	21	3	42
		% within AgeGroups	50.0%	7.1%	100.0%
	71-80	Count	2	0	3
		% within AgeGroups	66.7%	0.0%	100.0%
Total		Count	272	66	489
		% within AgeGroups	55.6%	13.5%	100.0%

One possible explanation for the decreased fatalities in the 61–70 age group could be the mean age of GA pilots in SA, which was 43.17 years ($n=490$, $sd=13.38$). Figure 4 clearly shows a peak of younger pilots in SA. The UK GA population had a significantly higher mean of 52.25 years ($n=491$, $sd=13.08$), as shown in Figure 5.

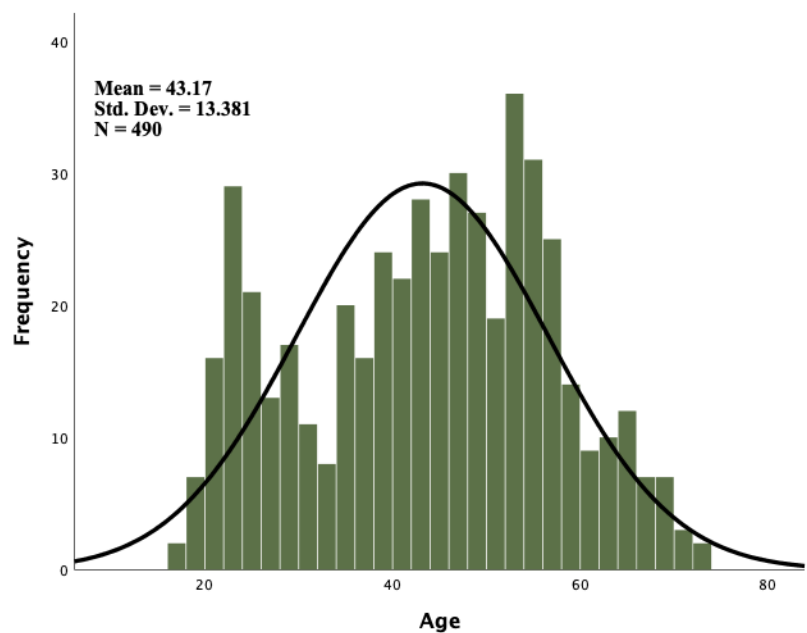


Figure 4 Age distribution of SA accident pilots

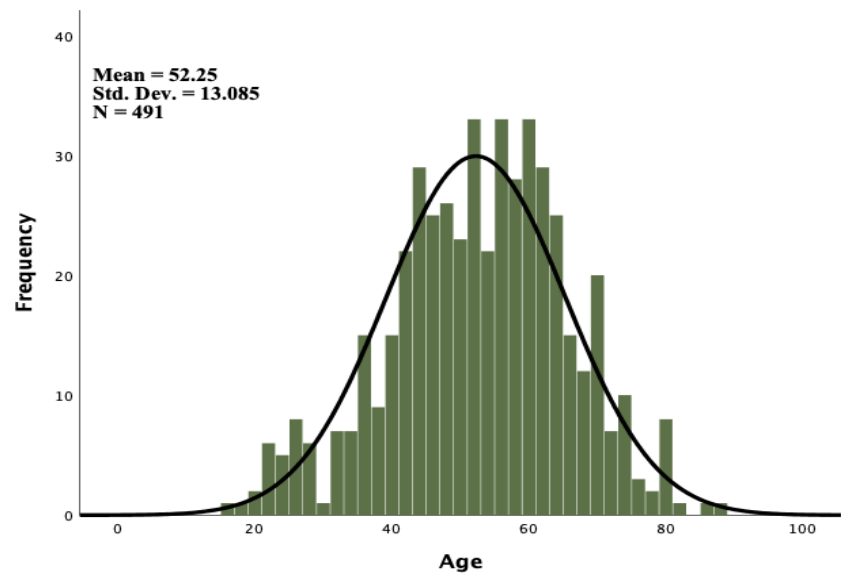


Figure 5 Age distribution of UK accident pilots

By combining the UK and SA data in a cross-tabulation, familiar trends emerged. Most pilots below the age of 20 years only suffered minor injuries (75%); this percentage gradually decreased till age 50. The transition group appeared again in the 51–60 age group, in which the percentage fatalities overtook the percentage of none/minor injuries. From 60 years onwards, the trend continued with as much as 64% of pilots above 70 years of age suffered fatal injuries and only a mere 27.3% suffered none/minor injuries. No clear identifiable trend was observed in the serious injury category (Table 4).

Table 4 SA and UK combined data of age groups and injuries

<i>Age Groups * Injuries Crosstabulation</i>						
		Injuries				
		None/Minor	Serious	Fatal	Total	
Age Groups	<20	Count	15	2	3	20
		% within Age Groups	75.0%	10.0%	15.0%	100.0%
	21–30	Count	77	9	34	120
		% within Age Groups	64.2%	7.5%	28.3%	100.0%
	31–40	Count	73	18	47	138
		% within Age Groups	52.9%	13.0%	34.1%	100.0%
	41–50	Count	133	34	88	255
		% within Age Groups	52.2%	13.3%	34.5%	100.0%
	51–60	Count	104	45	119	268
		% within Age Groups	38.8%	16.8%	44.4%	100.0%
	61–70	Count	51	24	68	143
		% within Age Groups	35.7%	16.8%	48%	100.0%
	71–80	Count	9	3	21	33
		% within Age Groups	27.3%	9.1%	64%	100.0%
	>80	Count	0	1	2	3
		% within Age Groups	0.0%	33.3%	67%	100.0%
Total		Count	462	136	382	980
		% within Age Groups	47.1%	13.9%	39.0%	100.0%

The GA survey had eight participants above the age of 50, five of which were above 60 years (See Appendix 1). Question 3.6 of the survey was a filtered question and only asked when the participant's age was above 60 years. It stated the following: *“Pilots over 60 years of age are considered more likely to be involved in an accident and thus require regular training and shorter licence validation intervals”*. All participants selected “Strongly disagree”.

It is possible that participants were experiencing the Dunning–Kruger effect (Kruger and Dunning, 1999) and over estimating their abilities. As they selected “Strongly disagree”, it is possible that the question might have even been

offending to the participant. Clearly, the participants believed that their age is not a factor (especially negative) in their ability to be safe pilots.

Question 3.8 of the survey stated the following: *“Due to cognitive skills decline, normally associated with age, it is recommended that pilots above the 60 years of age should fly more regularly (above 5 hours per month) to remain safe”*. The majority of participants disagreed with the statement and only one participant agreed with it. No research could be found to validate this rate as an attenuation of cognitive skills decline. However, expertise does play a role in attenuating cognitive decline (Kennedy et al., 2010) and relying on personal experience. Expertise is linked to currency.

Question 3.9 of the survey asked the following: *“What role do you think your age plays in your ability to be a safe pilot?”* The majority of participants selected that age plays no role in safety; one participant selected that age makes him slightly more unsafe, while two participants selected that age makes them safer pilots.

The results from the survey, although somewhat limited, indicate a disconnect between the accident data and the perception of pilots about the role their age plays in their ability to remain safe pilots. The results indicate that pilots above 50 years of age are more likely to be involved in fatal accidents and the likelihood increases with age. This supports Kennedy’s (2010) finding that older pilots are less likely to handle dynamic emergencies timeously. The findings also support the research of Demetriades et al. (2004) and Talvin et al. (2010) who found a significant correlation between age and injury severity in automobile pedestrian accidents and motorcycle accidents. Age clearly plays a significant role in the pilots’ ability to handle an emergency and also in the human body’s ability to survive physical trauma. Thus, survivability decreases with age.

4.2 Experience

Pilot experience was analysed to determine whether there was a correlation between pilot flight experience, currency and accident data. A hypothesis test was first done on UK data only (TT, n=486). The test results indicate a significance between the distribution of TT, TT90 days and TT28 days across

categories of injuries (TT Sig=0.31, TT90 Sig=0.00, TT28 Sig=0.00). The distribution of TT, TT90 and TT28 across injury categories is thus not the same across categories of injuries, as shown in Table 5. However, the distribution of TToT shows no significance (Sig=0.108) across categories of injuries; thus, the distribution of TToT was the same across all categories of injuries.

Table 5 Experience hypothesis test of the UK data.

<i>Hypothesis Test Summary</i>				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of TT is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.031	Reject the null hypothesis.
2	The distribution of 90 Days is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of 28 Days is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
4	The distribution of TT on Type is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.108	Retain the null hypothesis.

Note. Asymptotic significances are displayed. The significance level is .050. UK Data Only

The same hypothesis test on SA data (TT, n=485) yielded the following (Table 6): The distribution of TT was the same across categories of injuries (sig=.376). The null hypothesis was not the expected outcome and was different from the UK data. Thus, in the UK, there was a significance between the distribution of TT across categories of injuries; however, in SA, there was no significance between the distribution of TT across categories of injuries. SA accident reports did not record TT28, hence it was not included in the hypothesis test.

Table 6 Experience hypothesis test of SA data

<i>Hypothesis Test Summary</i>				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of TT is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.376	Retain the null hypothesis.
2	The distribution of 90 Days is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.013	Reject the null hypothesis.
3	The distribution of TT on Type is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.214	Retain the null hypothesis.

Note. Asymptotic significances are displayed. The significance level is .050. SA Data Only

Combining the UK and SA data in one hypothesis test (TT, n=970) yielded the following results: The SA hypothesis test was more likely to be the norm and the

UK hypothesis test was the exception, particularly in relation to the distribution of TT across categories of injuries.

Table 7 Experience hypothesis test of combined data of SA and the UK

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of TT is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.766	Retain the null hypothesis.
2	The distribution of 90 Days is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of 28 Days is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
4	The distribution of TT on Type is the same across categories of Injuries.	Independent-Samples Kruskal-Wallis Test	.848	Retain the null hypothesis.

Note. Asymptotic significances are displayed. The significance level is .050. SA and UK Data.

To test Craig's (2001) claims, a cross-tabulation of the TT data was done in 300-hour increments, with one exception of TT below 50 hours. The results cast doubt on Craigs' hypothesis that fatalities occur mostly between 50 to 350 TT; only 40.3% (n=146) off all accidents in the "Killing Zone" were fatal. The highest percentage of fatalities was in the TT 1551-1850 category (51.9%), although the accident number was low (n=140) which makes the data less reliable.

Table 8 Cross-tabulation of the TT data: Injuries*TT Groups * Injuries Crosstabulation*

			Injuries			Total
			None/Minor	Serious	Fatal	
TT Groups	<50	Count	22	6	16	44
		% within TT Groups	50.0%	13.6%	36.4%	100.0%
	51-350	Count	168	48	146	362
		% within TT Groups	46.4%	13.3%	40.3%	100.0%
	351-650	Count	60	26	63	149
		% within TT Groups	40.3%	17.4%	42.3%	100.0%
	651-950	Count	44	17	24	85
		% within TT Groups	51.8%	20.0%	28.2%	100.0%
	951-1250	Count	27	7	29	63
		% within TT Groups	42.9%	11.1%	46.0%	100.0%
	1251-1550	Count	17	7	10	34
		% within TT Groups	50.0%	20.6%	29.4%	100.0%
	1551-1850	Count	11	2	14	27
		% within TT Groups	40.7%	7.4%	51.9%	100.0%
	1851-2150	Count	17	1	8	26
		% within TT Groups	65.4%	3.8%	30.8%	100.0%
	2151-2450	Count	12	2	2	16
		% within TT Groups	75.0%	12.5%	12.5%	100.0%
	2451-2750	Count	10	4	6	20
		% within TT Groups	50.0%	20.0%	30.0%	100.0%
	2751-3050	Count	4	4	6	14
		% within TT Groups	28.6%	28.6%	42.9%	100.0%
	>3050	Count	69	9	51	129
		% within TT Groups	53.5%	7.0%	39.5%	100.0%
Total		Count	461	133	375	969
		% within TT Groups	47.6%	13.7%	38.7%	100.0%

Note. SA and UK Data.

Figure 6 represents a bar chart of the same data; it gives the visual impression that the TT 51-350 category was a high-risk category.

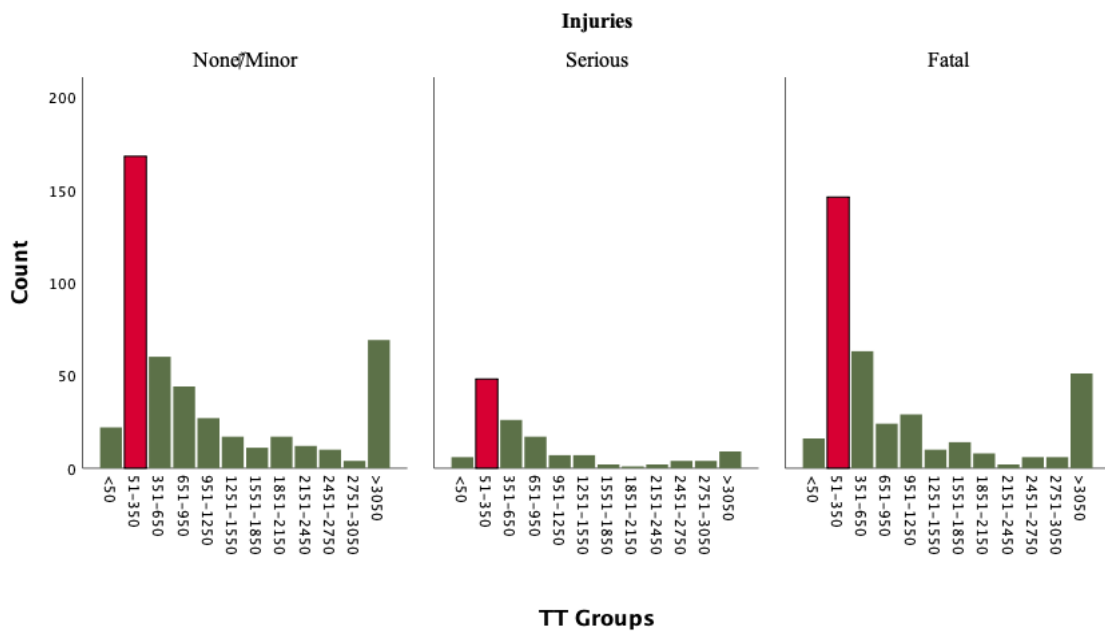


Figure 6 Distribution of pilot TT and injury severity

However, a cross-tabulation of all the accident data indicates that the largest accident frequency was in the TT 51-350 group and the second largest (15.4%) was in the next group of TT 351-650 (Table 9). To use only this data as evidence of a “Killing Zone” would be an error as it only reflected the population of accidents and omitted the distribution of TT in the entire GA population. As TT increased, the accident frequency became less. Considering the findings of Knecht (2013), the hypothesis of Craig (2001) can be explained by the fact that the number of GA pilots tends to decrease as TT increases. Taylor (2014) had a similar finding but attributed it not only to age, but also the cost factor of obtaining flight experience.

Table 9 Country cross-tabulation of the TT data per country

TT Groups * Country Crosstabulation

		Country		Total
		UK	SA	
TT Groups	<50	Count	16	28
		% within TT Groups	36.4%	63.6%
		% of Total	1.6%	2.9%
	51-350	Count	163	199
		% within TT Groups	45.0%	55.0%
		% of Total	16.8%	20.5%
	351-650	Count	87	62
		% within TT Groups	58.4%	41.6%
		% of Total	9.0%	6.4%
	651-950	Count	42	43
		% within TT Groups	49.4%	50.6%
		% of Total	4.3%	4.4%
	951-1250	Count	35	29
		% within TT Groups	54.7%	45.3%
		% of Total	3.6%	3.0%
	1251-1550	Count	19	15
		% within TT Groups	55.9%	44.1%
		% of Total	2.0%	1.5%
	1551-1850	Count	8	19
		% within TT Groups	29.6%	70.4%
		% of Total	0.8%	2.0%
	1851-2150	Count	12	14
		% within TT Groups	46.2%	53.8%
		% of Total	1.2%	1.4%
	2151-2450	Count	8	8
		% within TT Groups	50.0%	50.0%
		% of Total	0.8%	0.8%
	2451-2750	Count	13	7
		% within TT Groups	65.0%	35.0%
		% of Total	1.3%	0.7%
	2751-3050	Count	5	9
		% within TT Groups	35.7%	64.3%
		% of Total	0.5%	0.9%
	>3050	Count	78	51
		% within TT Groups	60.5%	39.5%
		% of Total	8.0%	5.3%
Total		Count	486	484
		% within TT Groups	50.1%	49.9%
		% of Total	50.1%	49.9%

Interviewees were asked whether they believe there is a “Killing Zone”, and if so at what TT. Every single interviewee rejected the term “Killing Zone” and preferred to refer to it as a “Danger Zone”, or just a TT time when a pilot tends to be overconfident and over-estimate their own abilities. The interviewees expressed that the “Danger Zone” is varied from uncertain to above 1,000 TT. No pattern could be identified. Interviewees were also asked for their opinion on the role that TT, TT90 and TToT play in safety. TT and TToT were considered to be important by the interviewees, but TT90 was only considered to be important by the flight instructor interviewee when the pilot has a low TT, but the pilot considered it less important at high TT.

A similar finding emerged from the analysis of the TT90 data (Figure 7). In all the three categories of injuries, most accidents happened with pilot TT90 below 10

hours. Again, the total GA population was omitted and considering costs associated with GA flying, the majority of the GA population was likely to fly less than 10 hours per 90 days. It can be deduced that the number of fatal accidents was more than the other injury categories.

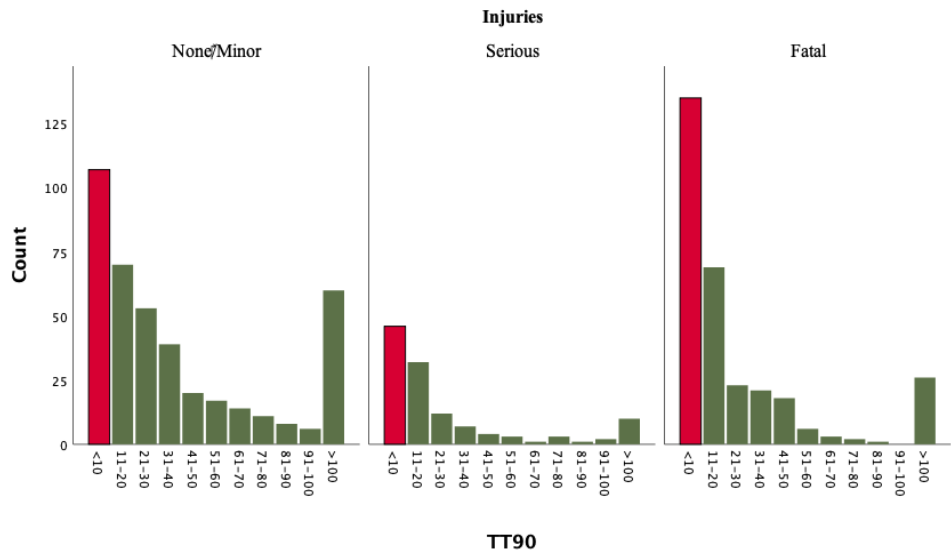


Figure 7 Analysis of the TT90 data and severity of injuries

A cross-tabulation of age and TT90 indicates a pattern consistent with the findings of Golaszewski (1983): A clear upward trend can be seen with age and TT90, although Golaszewski (1983) worked on a currency below 50 hours per year and this study only included the 90 days prior to the accident. Also, the upward trend of age was only noticeable in the below 10 hours per 90 days category.

Table 10 TT90 below 10 hours and age groups cross-tabulation

TT90 * Age Groups Crosstabulation										
		Age Groups								Total
TT90	<10	Count	<20	21-30	31-40	41-50	51-60	61-70	71-80	
			5	21	29	71	87	56	17	289
		% within TT90	1.7%	7.3%	10.0%	24.6%	30.1%	19.4%	5.9%	100.0%
		% within Age Groups	27.8%	21.4%	24.8%	33.0%	39.0%	44.4%	56.7%	100%
		% of Total	0.6%	2.5%	3.5%	8.6%	10.5%	6.7%	2.0%	34.8%

Note. SA and UK Data.

The sample size of gyrocopters (n=41) was too small to come to any reliable findings; therefore, it was not possible to test the findings of Pagán and De Voogt (2008).

4.3 Accident Causation

A cross-tabulation was performed between the CICTT categories and pilot age (using both UK and SA data combined). The results indicate that LOC-I had a significantly higher frequency than any other accident causation category. LOC-I accounted for 28.8% of all accidents. The closest other accident causation category was SCF-PP, which accounted for 20.9% of all accidents (Table 11). After the two afore-mentioned accident causations, the balance of the CICTT categories were all in single digits (% of total).

A clear correlation between age and the frequency of LOC-I accidents can also be identified. There was an upward trend from the <20 age group to the 71–80 age group. This trend further supports the findings under the age section. It could indicate that older pilots are less able to handle an emergency in their aircraft which would result in a LOC-I. The age distribution of accident pilots follows the normal distribution curve; however, the percentage of pilots that experience LOC-I accidents was an upward trend till age 80. Above 80 years, the sample size was too small with only one accident.

Table 11 CICTT and age groups cross-tabulation

CICTT * Age Groups Crosstabulation			Age Groups								Total
CICTT	ARC		<20	21-30	31-40	41-50	51-60	61-70	71-80	>80	
		Count	0	3	7	4	10	7	0	0	31
		% within CICTT	0.0%	9.7%	22.6%	12.9%	32.3%	22.6%	0.0%	0.0%	100.0%
		% within Age Groups	0.0%	2.5%	5.1%	1.6%	3.7%	4.9%	0.0%	0.0%	3.2%
		% of Total	0.0%	0.3%	0.7%	0.4%	1.0%	0.7%	0.0%	0.0%	3.2%
		Count	1	6	5	9	17	9	0	0	47
		% within CICTT	2.1%	12.8%	10.6%	19.1%	36.2%	19.1%	0.0%	0.0%	100.0%
		% within Age Groups	5.0%	5.0%	3.6%	3.5%	6.3%	6.3%	0.0%	0.0%	4.8%
		% of Total	0.1%	0.6%	0.5%	0.9%	1.7%	0.9%	0.0%	0.0%	4.8%
		Count	2	3	9	22	19	12	3	0	70
		% within CICTT	2.9%	4.3%	12.9%	31.4%	27.1%	17.1%	4.3%	0.0%	100.0%
		% within Age Groups	10.0%	2.5%	6.5%	8.6%	7.1%	8.4%	9.1%	0.0%	7.1%
		% of Total	0.2%	0.3%	0.9%	2.2%	1.9%	1.2%	0.3%	0.0%	7.1%
		Count	0	5	0	5	3	1	0	0	14
		% within CICTT	0.0%	35.7%	0.0%	35.7%	21.4%	7.1%	0.0%	0.0%	100.0%
		% within Age Groups	0.0%	4.2%	0.0%	2.0%	1.1%	0.7%	0.0%	0.0%	1.4%
		% of Total	0.0%	0.5%	0.0%	0.5%	0.3%	0.1%	0.0%	0.0%	1.4%
		Count	1	1	2	5	9	6	1	0	25
		% within CICTT	4.0%	4.0%	8.0%	20.0%	36.0%	24.0%	4.0%	0.0%	100.0%
		% within Age Groups	5.0%	0.8%	1.4%	2.0%	3.3%	4.2%	3.0%	0.0%	2.5%
		% of Total	0.1%	0.1%	0.2%	0.5%	0.9%	0.6%	0.1%	0.0%	2.5%
		Count	1	1	1	4	2	2	0	0	11
		% within CICTT	9.1%	9.1%	9.1%	36.4%	18.2%	18.2%	0.0%	0.0%	100.0%
		% within Age Groups	5.0%	0.8%	0.7%	1.6%	0.7%	1.4%	0.0%	0.0%	1.1%
		% of Total	0.1%	0.1%	0.1%	0.4%	0.2%	0.2%	0.0%	0.0%	1.1%
		Count	0	1	0	0	0	0	0	0	1
		% within CICTT	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
		% within Age Groups	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
		% of Total	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
		Count	1	3	4	5	6	1	1	0	21
		% within CICTT	4.8%	14.3%	19.0%	23.8%	28.6%	4.8%	4.8%	0.0%	100.0%
		% within Age Groups	5.0%	2.5%	2.9%	2.0%	2.2%	0.7%	3.0%	0.0%	2.1%
		% of Total	0.1%	0.3%	0.4%	0.5%	0.6%	0.1%	0.1%	0.0%	2.1%
		Count	5	13	9	14	22	5	0	1	69
		% within CICTT	7.2%	18.8%	13.0%	20.3%	31.9%	7.2%	0.0%	1.4%	100.0%
		% within Age Groups	25.0%	10.8%	6.5%	5.5%	8.2%	3.5%	0.0%	33.3%	7.0%
		% of Total	0.5%	1.3%	0.9%	1.4%	2.2%	0.5%	0.0%	0.1%	7.0%
		Count	2	32	39	76	75	46	12	1	283
		% within CICTT	0.7%	11.3%	13.8%	26.9%	26.5%	16.3%	4.2%	0.4%	100.0%
		% within Age Groups	10.0%	26.7%	28.3%	29.8%	27.9%	32.2%	36.4%	33.3%	28.8%
		% of Total	0.2%	3.3%	4.0%	7.7%	7.6%	4.7%	1.2%	0.1%	28.8%
		Count	0	5	5	4	6	6	2	0	28
		% within CICTT	0.0%	17.9%	17.9%	14.3%	21.4%	21.4%	7.1%	0.0%	100.0%
		% within Age Groups	0.0%	4.2%	3.6%	1.6%	2.2%	4.2%	6.1%	0.0%	2.9%
		% of Total	0.0%	0.5%	0.5%	0.4%	0.6%	0.6%	0.2%	0.0%	2.9%
		Count	1	5	7	25	18	15	2	1	74
		% within CICTT	1.4%	6.8%	9.5%	33.8%	24.3%	20.3%	2.7%	1.4%	100.0%
		% within Age Groups	5.0%	4.2%	5.1%	9.8%	6.7%	10.5%	6.1%	33.3%	7.5%
		% of Total	0.1%	0.5%	0.7%	2.5%	1.8%	1.5%	0.2%	0.1%	7.5%
		Count	0	3	2	1	1	0	0	0	7
		% within CICTT	0.0%	42.9%	28.6%	14.3%	14.3%	0.0%	0.0%	0.0%	100.0%
		% within Age Groups	0.0%	2.5%	1.4%	0.4%	0.4%	0.0%	0.0%	0.0%	0.7%
		% of Total	0.0%	0.3%	0.2%	0.1%	0.1%	0.0%	0.0%	0.0%	0.7%
		Count	0	8	21	22	28	12	4	0	95
		% within CICTT	0.0%	8.4%	22.1%	23.2%	29.5%	12.6%	4.2%	0.0%	100.0%
		% within Age Groups	0.0%	6.7%	15.2%	8.6%	10.4%	8.4%	12.1%	0.0%	9.7%
		% of Total	0.0%	0.8%	2.1%	2.2%	2.9%	1.2%	0.4%	0.0%	9.7%
		Count	6	31	27	59	53	21	8	0	205
		% within CICTT	2.9%	15.1%	13.2%	28.8%	25.9%	10.2%	3.9%	0.0%	100.0%
		% within Age Groups	30.0%	25.8%	19.6%	23.1%	19.7%	14.7%	24.2%	0.0%	20.9%
		% of Total	0.6%	3.2%	2.8%	6.0%	5.4%	2.1%	0.8%	0.0%	20.9%
		Count	20	120	138	255	269	143	33	3	981
		% within CICTT	2.0%	12.2%	14.1%	26.0%	27.4%	14.6%	3.4%	0.3%	100.0%
		% within Age Groups	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	2.0%	12.2%	14.1%	26.0%	27.4%	14.6%	3.4%	0.3%	100.0%

Note. SA and UK Data

Figures 8 and 9 demonstrate that LOC-I was not only the highest frequency causation, but it was also responsible for the most fatalities. The second-highest causation was SCF-PP; however, it was not the second-highest cause of fatalities, with the majority of SCF-PP resulting in minor or no injuries. CFIT was responsible for the second-highest rate of fatalities with the majority of all CFIT accidents being fatal.

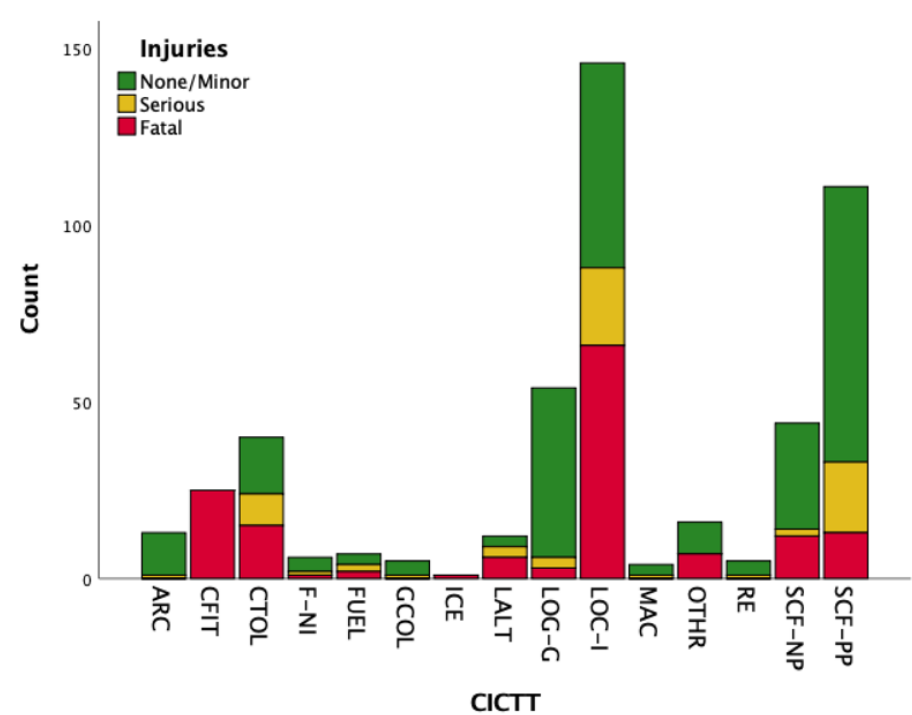


Figure 8 Severity of Injuries per CICTT category.

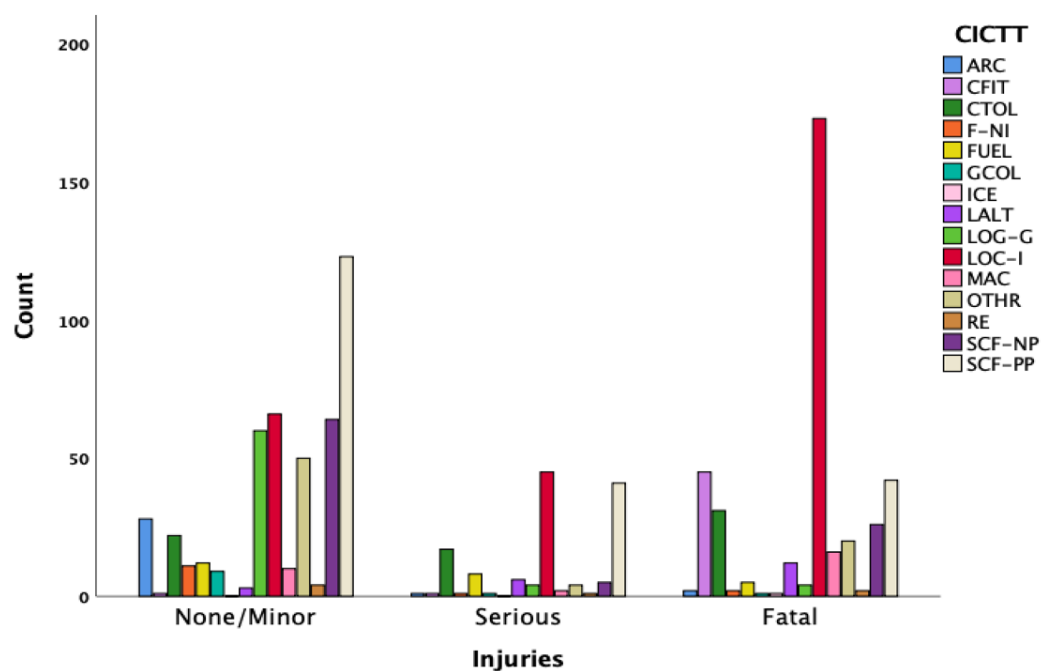


Figure 9 CICTT occurrences per Injury Category.

When the data was categorised by aircraft type, most accidents were in the fixed-wing category (Figure 10). This again was likely due to the population of GA pilots who fly fixed-wing aircraft being larger than all the other categories. There was a small number of serious injuries in the gyrocopter and glider class. Glider accidents were mostly fatal and gyrocopter accidents were either fatal or only minor or no injuries occurred.

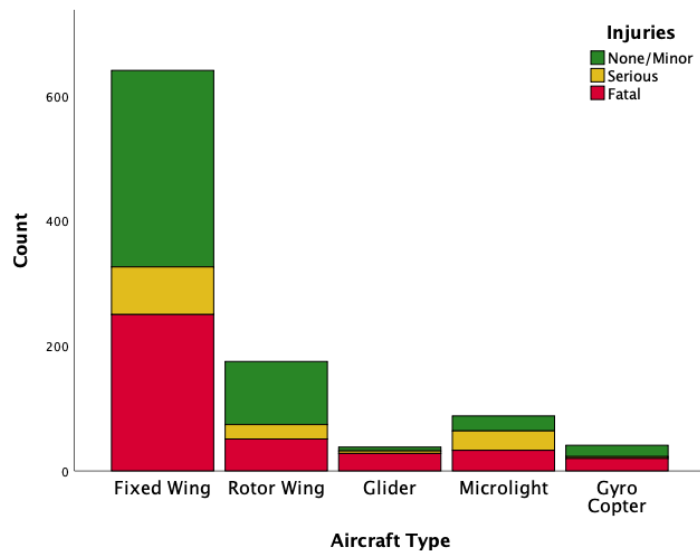


Figure 10 Injuries per aircraft type

When the data was categorised per country and analysed using a stacked bar chart, similar trends between the three injuries categories were obtained (Figure 11). SA had fewer fatalities than the UK for a near same number of accidents. Both countries had most injuries either in the fatal category or none/minor category. Serious injuries were the smallest category in both countries.

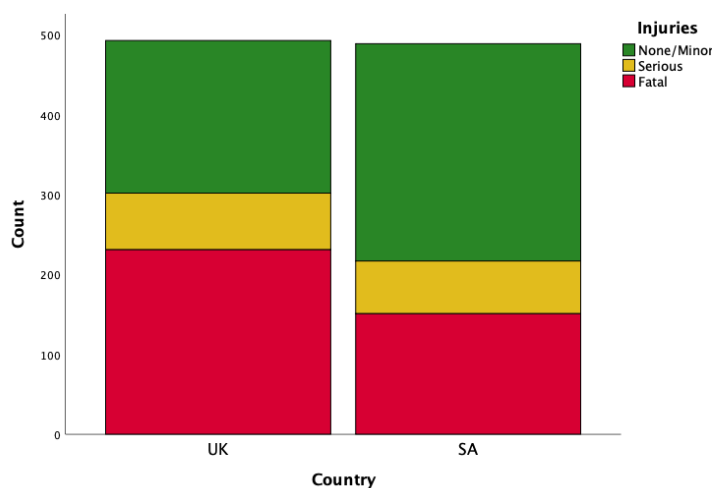


Figure 11 Injuries per Country

Using CICTT categories, a number of trends were observed. Both countries had a similar trend in causations, particularly Control Flight into Terrain (CFIT), Loss of Control In-flight (LOC-I), Abnormal Runway Contact (ARC) and

System/Component Failure – Non-Power Plant (SCF-NP). SA had a notably higher frequency of System/Component Failure – Power Plant (SCF-PP) (Figure 12). The UK had a significantly higher number of Mid Air Collisions (MAC); this could be due to the prevalence of controlled airspace and the size of the GA population as well as the geographic size of the country (UK=242 495 Km², SA=1 219 090 Km²; Statista, n.d.). This study did not include the total GA population size of both countries; however, even if they were the same, SA is still five times larger in land space than the UK. This makes the probability of a MAC much lower in SA.

Two countries in two different hemispheres indicating similar accident trends are a cause for concern, and it is recommended that further research be done on this topic.

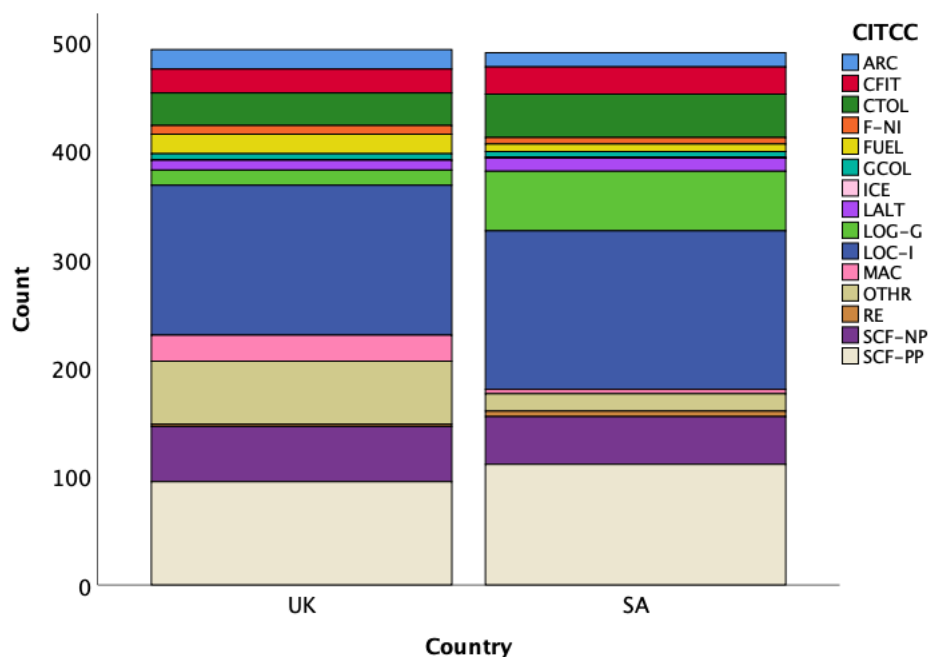


Figure 12 CICTT categories per country

The results correspond with the findings of Owens (2018) with regard to the most common occurrence (LOC-I); however, they differ from those of Owens (2018) with respect to the second and third most common occurrence. In the UK and SA combined data, the second most common occurrence was SCF-PP (20.9% of Total) and SCF-NP (9.7% of Total).

A cross-tabulation between CICTT and phase of flight indicates that LOC-I occurred most in the take-off phase (40%; Table 12); however, in this thesis, the landing phase had been broken up into two phases: approach phase and landing phase. Using two phases of flight for the landing sequence is not consistent with other researchers (Owens, 2018; Taylor, 2014). Therefore, by combining the two landing phases (Approach=32.3%, Landing=16.3%), the data indicates that LOC-I occurrences mostly occurred during the landing sequence (Total=48.6%).

Table 12 CICTT and phase of flight cross-tabulation

CICTT * Phase of Flight Crosstabulation			Phase of Flight							Total
CICTT	ARC		Standing	Taxi	Take Off	En-Route	Approach	Landing	Unknown	
		Count	0	0	5	0	0	26	0	31
		% within CICTT	0.0%	0.0%	16.1%	0.0%	0.0%	83.9%	0.0%	100.0%
		% within Phase of Flight	0.0%	0.0%	2.2%	0.0%	0.0%	12.8%	0.0%	3.2%
		% of Total	0.0%	0.0%	0.5%	0.0%	0.0%	2.6%	0.0%	3.2%
	CFIT	Count	0	0	0	45	2	0	0	47
		% within CICTT	0.0%	0.0%	0.0%	95.7%	4.3%	0.0%	0.0%	100.0%
		% within Phase of Flight	0.0%	0.0%	0.0%	11.8%	2.2%	0.0%	0.0%	4.8%
		% of Total	0.0%	0.0%	0.0%	4.6%	0.2%	0.0%	0.0%	4.8%
	CTOL	Count	0	0	13	15	18	24	0	70
		% within CICTT	0.0%	0.0%	18.6%	21.4%	25.7%	34.3%	0.0%	100.0%
		% within Phase of Flight	0.0%	0.0%	5.7%	3.9%	19.4%	11.8%	0.0%	7.1%
		% of Total	0.0%	0.0%	1.3%	1.5%	1.8%	2.4%	0.0%	7.1%
	F-NI	Count	1	0	1	9	0	3	0	14
		% within CICTT	7.1%	0.0%	7.1%	64.3%	0.0%	21.4%	0.0%	100.0%
		% within Phase of Flight	7.7%	0.0%	0.4%	2.4%	0.0%	1.5%	0.0%	1.4%
		% of Total	0.1%	0.0%	0.1%	0.9%	0.0%	0.3%	0.0%	1.4%
	FUEL	Count	0	0	5	13	4	2	1	25
		% within CICTT	0.0%	0.0%	20.0%	52.0%	16.0%	8.0%	4.0%	100.0%
		% within Phase of Flight	0.0%	0.0%	2.2%	3.4%	4.3%	1.0%	2.3%	2.5%
		% of Total	0.0%	0.0%	0.5%	1.3%	0.4%	0.2%	0.1%	2.5%
	GCOL	Count	0	4	3	1	0	3	0	11
		% within CICTT	0.0%	36.4%	27.3%	9.1%	0.0%	27.3%	0.0%	100.0%
		% within Phase of Flight	0.0%	19.0%	1.3%	0.3%	0.0%	1.5%	0.0%	1.1%
		% of Total	0.0%	0.4%	0.3%	0.1%	0.0%	0.3%	0.0%	1.1%
	ICE	Count	0	0	0	1	0	0	0	1
		% within CICTT	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
		% within Phase of Flight	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.1%
		% of Total	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
	LALT	Count	0	0	1	15	1	0	4	21
		% within CICTT	0.0%	0.0%	4.8%	71.4%	4.8%	0.0%	19.0%	100.0%
		% within Phase of Flight	0.0%	0.0%	0.4%	3.9%	1.1%	0.0%	9.3%	2.1%
		% of Total	0.0%	0.0%	0.1%	1.5%	0.1%	0.0%	0.4%	2.1%
	LOG-G	Count	9	9	8	0	1	41	1	69
		% within CICTT	13.0%	13.0%	11.6%	0.0%	1.4%	59.4%	1.4%	100.0%
		% within Phase of Flight	69.2%	42.9%	3.5%	0.0%	1.1%	20.2%	2.3%	7.0%
		% of Total	0.9%	0.9%	0.8%	0.0%	0.1%	4.2%	0.1%	7.0%
	LOC-I	Count	0	0	92	110	30	33	19	284
		% within CICTT	0.0%	0.0%	32.4%	38.7%	10.6%	11.6%	6.7%	100.0%
		% within Phase of Flight	0.0%	0.0%	40.0%	28.9%	32.3%	16.3%	44.2%	28.9%
		% of Total	0.0%	0.0%	9.4%	11.2%	3.1%	3.4%	1.9%	28.9%
	MAC	Count	0	0	1	17	9	1	0	28
		% within CICTT	0.0%	0.0%	3.6%	60.7%	32.1%	3.6%	0.0%	100.0%
		% within Phase of Flight	0.0%	0.0%	0.4%	4.5%	9.7%	0.5%	0.0%	2.8%
		% of Total	0.0%	0.0%	0.1%	1.7%	0.9%	0.1%	0.0%	2.8%
	OTHR	Count	1	6	11	23	3	19	11	74
		% within CICTT	1.4%	8.1%	14.9%	31.1%	4.1%	25.7%	14.9%	100.0%
		% within Phase of Flight	7.7%	28.6%	4.8%	6.1%	3.2%	9.4%	25.6%	7.5%
		% of Total	0.1%	0.6%	1.1%	2.3%	0.3%	1.9%	1.1%	7.5%
	RE	Count	0	0	5	0	1	1	0	7
		% within CICTT	0.0%	0.0%	71.4%	0.0%	14.3%	14.3%	0.0%	100.0%
		% within Phase of Flight	0.0%	0.0%	2.2%	0.0%	1.1%	0.5%	0.0%	0.7%
		% of Total	0.0%	0.0%	0.5%	0.0%	0.1%	0.1%	0.0%	0.7%
	SCF-NP	Count	2	2	10	32	2	43	4	95
		% within CICTT	2.1%	2.1%	10.5%	33.7%	2.1%	45.3%	4.2%	100.0%
		% within Phase of Flight	15.4%	9.5%	4.3%	8.4%	2.2%	21.2%	9.3%	9.7%
		% of Total	0.2%	0.2%	1.0%	3.3%	0.2%	4.4%	0.4%	9.7%
	SCF-PP	Count	0	0	75	99	22	7	3	206
		% within CICTT	0.0%	0.0%	36.4%	48.1%	10.7%	3.4%	1.5%	100.0%
		% within Phase of Flight	0.0%	0.0%	32.6%	26.1%	23.7%	3.4%	7.0%	21.0%
		% of Total	0.0%	0.0%	7.6%	10.1%	2.2%	0.7%	0.3%	21.0%
Total		Count	13	21	230	380	93	203	43	983
		% within CICTT	1.3%	2.1%	23.4%	38.7%	9.5%	20.7%	4.4%	100.0%
		% within Phase of Flight	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	1.3%	2.1%	23.4%	38.7%	9.5%	20.7%	4.4%	100.0%

Note. SA and UK Data

4.4 Training

A cross-tabulation was conducted using only occurrences classed as “Training”. Data from both UK and SA (n=148) was analysed. Training accidents were mostly recorded with the instructor as PIC unless the student was flying solo. Thus, the only licence category that guaranteed that there was only a student pilot on board would be the SPL licence category. In this category, there were no significant findings; 29.4% of the occurrences were fatal and the majority of occurrences (58.8%) resulted in only minor or no injuries.

Table 13 Training injuries and license cross-tabulation

*Injuries * License Crosstabulation*

			License						Total
			SPL	NPL	PPL	CPL	ATPL	Glider Cert	
Injuries	None/Minor	Count	20	4	11	44	14	0	93
		% within Injuries	21.5%	4.3%	11.8%	47.3%	15.1%	0.0%	100.0%
		% within License	58.8%	50.0%	55.0%	68.8%	70.0%	0.0%	62.8%
	Serious	Count	4	3	5	3	2	1	18
		% within Injuries	22.2%	16.7%	27.8%	16.7%	11.1%	5.6%	100.0%
		% within License	11.8%	37.5%	25.0%	4.7%	10.0%	50.0%	12.2%
	Fatal	Count	10	1	4	17	4	1	37
		% within Injuries	27.0%	2.7%	10.8%	45.9%	10.8%	2.7%	100.0%
		% within License	29.4%	12.5%	20.0%	26.6%	20.0%	50.0%	25.0%
Total	Count		34	8	20	64	20	2	148
	% within Injuries		23.0%	5.4%	13.5%	43.2%	13.5%	1.4%	100.0%
	% within License		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note. SA and UK Data

Figure 13 presents a clustered bar chart of the training data. The majority of all training accidents resulted in minor to no injuries and were recorded under the instructor (ATPL, CPL) licence. Glider training accidents were almost all serious injuries or fatal.

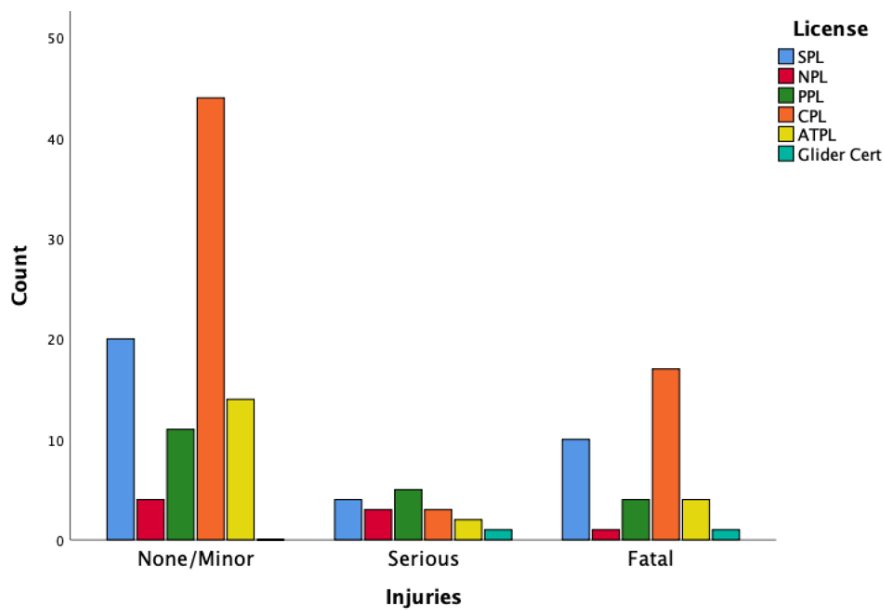


Figure 13 License type per Injury Category

The phase of flight was of greater importance: A cross-tabulation between injuries and phase of flight indicates that the most fatal accidents occurred in the approach phase of the flight (Table 14). In GA, this would be more commonly known as the traffic circuit. If landing and approach were counted as one category, the total number of fatal accidents would increase to 57.7%. Take-off accounted for 18.9% of all fatalities. Low-level flying in the traffic circuit accounted for 76.6% of all fatalities and 59.8% of all training accidents. These results thus support the findings of Taylor (2014).

Table 14 Phase of flight and injuries cross-tabulation*Phase of Flight * Injuries Crosstabulation*

			Injuries			
			None/Minor	Serious	Fatal	Total
Phase of Flight	Standing	Count	4	0	0	4
		% within Phase of Flight	100.0%	0.0%	0.0%	100.0%
		% within Injuries	4.3%	0.0%	0.0%	2.7%
	Taxi	Count	5	0	0	5
		% within Phase of Flight	100.0%	0.0%	0.0%	100.0%
		% within Injuries	5.3%	0.0%	0.0%	3.4%
	Take Off	Count	17	5	7	29
		% within Phase of Flight	58.6%	17.2%	24.1%	100.0%
		% within Injuries	18.1%	27.8%	18.9%	19.5%
	En Route/Maneuvering	Count	24	4	17	45
		% within Phase of Flight	53.3%	8.9%	37.8%	100.0%
		% within Injuries	25.5%	22.2%	45.9%	30.2%
	Approach	Count	2	2	4	8
		% within Phase of Flight	25.0%	25.0%	50.0%	100.0%
		% within Injuries	2.1%	11.1%	10.8%	5.4%
	Landing	Count	42	6	4	52
		% within Phase of Flight	80.8%	11.5%	7.7%	100.0%
		% within Injuries	44.7%	33.3%	10.8%	34.9%
	Unknown	Count	0	1	5	6
		% within Phase of Flight	0.0%	16.7%	83.3%	100.0%
		% within Injuries	0.0%	5.6%	13.5%	4.0%
Total	Count	94	18	37	149	
	% within Phase of Flight	63.1%	12.1%	24.8%	100.0%	
	% within Injuries	100.0%	100.0%	100.0%	100.0%	

Note. SA and UK Data

Since LOC-I is closely related to pilot speed awareness and upset recovery skills (Boatman, 2019; Taylor, 2014), the logical step would be to investigate how pilots perceive their ability to be speed aware (in-flight) and to recover from an inadvertent upset in flight, particularly, how it is dealt with in training and post licence revalidation. Since the accident data did not reflect this part of the main objective, the findings were reliant on interviews and isolated questions from the survey (Appendix 1). The participants were asked whether they ever received any upset recovery training after obtaining their private pilot licence (or national pilot licence). About 43.75% of the participants indicated that they had never received any further upset recovery training post obtaining their licence. Also, 75% of the participants indicated that they had never been in or near an inadvertent aerodynamic stall but 60% rated themselves as “fully confident” in their ability to recover from an aerodynamic stall. The findings indicate that it is possible the pilots were over-estimating their ability and unaware of their actual

skill level, which could be attributed to the Dunning–Kruger effect (Kruger and Dunning, 1999).

When the participants asked which of the following they consider more important:

- Strong recovery skill set training
- Prevention of low-speed scenarios through speed awareness training

The results were exactly 50% for each. The option “Both” was deliberately excluded in order to force the participants to choose one option above the other. The same question was then posted on a social media pilot group (see Appendix 2) which caused a lengthy debate but also reflected the division of opinion.

The flight instructor interviewee appeared very confident in his speed awareness training. The Chief Flight Instructor (CFI) overseeing him also indicated that speed awareness was a focal point in their flight training syllabus. Directly following the interview with the flight instructor, one of the interviewee’s students were interviewed in his presence. The student with TT 19 also indicated that she was very confident in her speed awareness ability. The following scenario was presented to the student interviewee: *“You are on a training flight, in the downwind leg. You turned final approach, and halfway in the turn, you realised that you had overshoot the runway centre line. What do you do?”* The student responded that she would increase the bank angle and continue her turn until she is aligned with the centre line. The interviewee was asked where his eyes would be during the increased bank angle turn; the interviewee responded that he would keep his eyes on the runway centreline. His reply visibly shook the instructor. The student’s reply indicated that he lacked the knowledge of the risk of an inadvertent aerodynamic stall at low altitude when he increased the bank angle at a low power setting.

The CFI interviewees were asked about upset recovery training, in particular spin training. The CFI shared concerns about upset recovery training and the fact that spin training is no longer done as part of their PPL syllabus. Due to cost implications, cheaper non-type certified aircraft (e.g., A22 Foxbat, Cirrus SR22) are now very popular for training schools. Unfortunately, the limitation with these aircraft is that they are often not spin rated. As a result, a fully qualified PPL can

be flying with almost no spin or upset recovery training. Combined with possible poor speed awareness training, the risk of a LOC-I occurrence is very high. There is currently no simulator available to realistically simulate an upset recovery situation. Flight instructor interviewees also reluctantly admitted that they are uncomfortable with any stall, spin or upset recovery training, partly due to the shortfalls in their own training. A crosstabulation of training accidents per country reveals that both countries experienced almost the exact same amount of training accidents.

Table 15 Country and Type Crosstabulation

*Country * Type Crosstabulation*

Count		Type			Total
		Private	Training	Aerobatics	
Country	UK	398	74	21	493
	SA	410	75	5	490
Total		808	149	26	983

5 Discussion

5.1 Age

The minimum age to obtain a Private Pilot Licence (PPL) in the UK (UK Civil Aviation Authority, n.d.) and SA (South African Civil Aviation Authority, 2008) is set at 17 years of age, with no maximum age limit set. Both regulators chose not to set a maximum age for obtaining a PPL. Instead, they opted to rely on Designated Aviation Medical Examiners (DAME). Therefore, should a prospective or current pilot be deemed medically fit to fly by the DAME, that person can legally act as a pilot in command of an aircraft, irrespective of their age.

The FAA designated medical examiners guide states; *“Neuropsychological assessment should be undertaken if there are any clinical concerns about cognitive impairment”* (Federal Aviation Administration, 2017, p169). Apart from those “clinical concerns”, the presence of age-related cognitive impairment is mostly left to the discretion of the Aviation Medical Examiner (AME).

Once a pilot has obtained a PPL, the pilot is required to do annual revalidation of the licence. In the UK, the requirements are stated as follows:

“within the 12 months preceding the expiry date of the rating, complete 12 hours of flight time in the relevant class, including:

- *hours as PIC;*
- *12 take-offs and 12 landings; and*
- *refresher training of at least 1 hour with a flight instructor (FI) or a class rating instructor (CRI).”* (UK CAA, 2013, FCL.740.A (bii))

There is no age-related difference in the requirements to revalidate an existing PPL. As long as pilots are deemed medically fit, they can revalidate their licences as many times as they want and continue to operate as pilots in command of aircraft. However, the results show a significant correlation between the severity of injuries and age. Also, the GA population in the UK was much older (Mean=52.25, SD=13.38) than the SA population (Mean=43.17, SD=13.08). Taylor (2014) demonstrated a correlation between pilot age and TT due to cost

implications. The lower age mean and the bimodal age distribution of SA pilots could explain why there was no significance in the distribution of TT across categories of injuries.

Therefore, an assumption can be made that the regulators do not recognise the impact of age-related cognitive decline by having the same set of revalidation requirements for pilots of all ages. It can be deduced that the regulators do not consider age as a risk factor in GA.

Based on the literature and the findings of this thesis, it would be advisable for regulators to implement age-based licence revalidation criteria. Annual upset recovery training should be compulsory for all GA pilots, with the number of upset recovery training hours increasing with pilot age.

Slower processing speed due to cognitive decline, which is associated with age, could reduce the pilot's ability to deal with an emergency timeously. The findings, thus, support the work of Salthouse (2009) and Murman (2015).

Although in this thesis, pilot gender was not taken into consideration, the findings support Bazargan and Guzhva's (2011) conclusion that males above the age of 60 years are more likely to be involved in a fatal accident. The findings also validate the "Age 60 Rule" that has been utilised by the FAA since 1959. It is worth noting that the "Age 60 Rule" applies to commercial aviation and this thesis only included GA. The advancement of technology in modern aircraft reduces the role of the pilot and at least in commercial aviation; therefore, the "Age 60 Rule" could possibly be outdated. Further research in the commercial aviation population would be useful.

Older pilots, especially those with high TT but low currency tend to overestimate their abilities and suffer a dual burden by not realising that they are overconfident in their abilities (Kruger and Dunning, 1999). In the absence of pilots' own recognition of their potential safety risks, the responsibility to mitigate the risk would be up to the regulator to address. Higher currency age-related revalidation requirements could have two possible consequences: either GA pilots retire from flying at a younger age or alternatively they comply with the requirements and be

more proficient pilots. The data also indicate a spike in younger pilots in SA. The same is not nearly as evident in the UK because it is not clear. Further research would be needed to clarify this finding.

5.2 Experience

Since GA is normally a single-pilot operation and risk-mitigating barriers are considerably less than in commercial aviation, the safety of the flight relies heavily on the pilot. Two fundamental aspects are in play: the pilots' ability to deal with an unexpected emergency and the pilots' aeronautical decision making (ADM) skills. ADM skills appear less researched and harder to predict. Pilots with more experience are less likely to take on risk, for example, flying into instrument meteorological conditions (Wiegmann, Goh and O'Hare, 2002). However, other factors such as age, personality (e.g., risk-taking appetite and thrill-seeker), self-confidence and culture also play a role in ADM (Drinkwater and Molesworth, 2010). The Aviation Safety Attitude Scale (ASAS) was developed in an attempt to assist aviators with ADM (Hunter, 2006).

This thesis focuses more on pilots' ability to deal with an emergency. It is believed that no substitute exists for experience; however, flight currency appears to be of equal importance. The ability to pilot an aircraft safely is a diminishing skill. Regardless of how many flight hours a pilot has accumulated, if the skill is not regularly exercised, the pilot becomes less likely to be able to handle an emergency effectively. The dual burden is also that pilots might not be aware of their diminishing skill (Kruger and Dunning, 1999).

The killing zone determined by Craig (2001) cannot be employed as accurate identification of a high-risk TT zone. Further research that includes the TT distribution of the GA population could be valuable (Knecht, 2013). The data indicates that flight experience on any particular make and model of aircraft has no significant correlation to the severity of injuries. Further research using data from other countries will be required to confirm the norm.

5.3 Accident Causation

Accidents in a complex system such as aviation rarely, if ever, occur due to a single event but instead through the accumulation of multiple factors and failures. Reason (1990) developed the current widely used Swiss Cheese Model (SCM) of accident causation, with each cheese slice representing a safety barrier. The holes in the cheese slices represent weaknesses in the safety barrier; if and when these holes line up, an accident occurs (Reason, 1990). The model has undergone a great deal of scrutiny and critique since then, even by the author himself. It was argued that the model does not account for the interrelationships among causal factors and that without these clear linkages, the results of the model are too vague for practical use (Luxhøj and Kauffeld, 2003).

Nonetheless, the model illustrates one clear point: There are considerably fewer safety barriers in GA. Commercial operations benefit from advanced safety equipment, such as traffic collision avoidance system (TCAS), enhanced ground proximity warning system (EGPWS), advanced weather radar, flight data monitoring (FDM). The lack of safety barriers reflects in the crash data of GA compared to commercial aviation. This thesis did not find new significant findings with relation to accident causation; however, its findings support the findings of previous researchers. LOC-I at low altitude, typically within the traffic pattern, is still considerably higher than other accident causations and responsible for the majority of fatalities in GA. The findings are consistent with those of Taylor (2014) who also used UK data, but not SA data. One common finding between this thesis and the findings of Owens (2018) and Taylor (2014) is that, regardless of which phase of flight, LOC-I is considered the most common; all occurrences are directly linked to low-level flying. It is better to crash an aeroplane under control than to be a “passenger” in your own uncontrolled aircraft.

The thesis supports a famous quote by Bob Hoover (Hoover, n.d.): *“If you’re faced with a forced landing, fly the thing as far into the crash as possible.”* An uncontrolled aircraft is a deadly machine to be in. Although it has been known for a number of years, LOC-I remains a significant problem.

5.4 Training

The interviewees stated that they believe in SA, being a flight instructor is considered a steppingstone and necessary for building hours only. Career instructors are a minority. One reason given by the interviewees is that the income potential for a flight instructor in SA is very low. It is, therefore, not considered an attractive career choice. The majority of flight instructors in SA are, therefore, low time pilots and often are not fully capable of handling an upset recovery situation due to a lack of experience.

Contrary to SA, the UK has more career instructors since the remuneration is more attractive. Therefore, as per interviewees, the UK has more experienced instructors and it could be argued that the level of training in the UK is better than SA.

Although the SA data accumulated in almost half the time of the UK data and the UK GA population is larger, the percentage of training accidents of overall accident count for SA and the UK is almost the same (7.6% and 7.5%, respectively). The reasons behind this are not yet known and beyond the scope of this thesis.

Training organizations need to pay more attention to upset recovery skills and speed awareness training. It would be better to teach pupils on the risks attributed to LOC-I in the traffic pattern than to build their confidence in their abilities. Although confidence is important, an overconfident student should be a cause for concern. The small margin for error in the traffic pattern appears to be downplayed or underemphasized by training schools. A realistic upset recovery simulator, capable of simulating stalls, spins and spiral dives would be of great value to the GA training community.

6 Conclusion

This thesis analysed publicly available accident reports from two different countries in order to analyse differences, correlations and trends between the countries. The research found a number of similar trends between the two countries. The ratio between fatal, serious and minor/none injuries was found to be remarkably similar. Both countries experienced almost exactly the same amount of training accidents in relation to total number of accidents. SA experienced significantly more SCF-PP occurrences, but at the same time, a much higher percentage of them were only minor or no injuries. The UK experienced significantly more fatalities than SA, but both countries experienced a similar number of serious injuries. Most accidents resulted in either minor or no injuries or they are fatal. This supports the age-old hanger talk fable that you either walk away or you die in an air crash.

Gliders accidents were majority fatal in both countries with gyrocopters and microlights, not proving to be very safe as the data indicates low survivability. This could be due to the lack of a protective cabin (capsule) for the pilot.

Pilot age played a significant role in the pilots' ability to deal with an emergency, and the fatality rate increased noticeably with the pilot age. A clear correlation between pilot age, experience and currency was noted. Regulators should, therefore, consider age-related licence revalidation criteria. With older pilots, flight currency could compensate for lower fluid abilities (processing speed). Therefore, to remain a safe and proficient pilot, it is recommended that older pilots fly more often to maintain their licence. Age-related survivability shows the same trend than in aviation than what was discovered in motorcycle accidents and automobile pedestrian accidents.

This thesis supports the findings of other researchers with respect to accident causation: LOC-I inside the traffic pattern remains the biggest killer in GA despite the fact it is known for a number of years now.

The limited safety barriers, compared to commercial aviation, reflected in the accident data. Exploring new ways to bring GA safety standards closer to commercial aviation must be a priority.

A global standard template for all accident investigation reports, which include phase of flight and CICTT codes for accident causation, would greatly assist and promote more accurate future statistical analysis.

Accident investigation plays a critical role in aviation safety, and the safety recommendations in these reports are vitally important. Beyond the recommendations, the accident data itself also proved to be valuable to promote aviation safety by identifying trends, differences and correlations. The research question and aim were achieved in this thesis as the statistical analysis of accident reports can clearly promote aviation safety.

7 Acknowledgements

An undertaking such as this could not be completed without the support of numerous people, including family members, friends, work colleagues and the lecturers and staff at Cranfield University.

I owe a special thanks to my research supervisor, Dr Leigh Dunn for his helpful suggestions and guidance throughout the process and to Saryani Asmayawati for her help and support throughout the entire journey. It was indeed a privilege to learn from you both.

I am especially grateful to Liberty Life, South Africa and in particular Dhiren Sivjattan who made it possible for me to complete this life-changing qualification.

Finally, to God Almighty. May all the Glory be His.

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Appendices

Appendix 1: Results report of the survey

Appendix 2: Screenshot of Social media discussion

Appendix 3: Extract of raw accident data in Excel format

Appendix 4: Extract of cleaned SPSS data

Appendix 5: Interview consent form

Appendix 6: Interview plan

Appendix 7: CURES approval

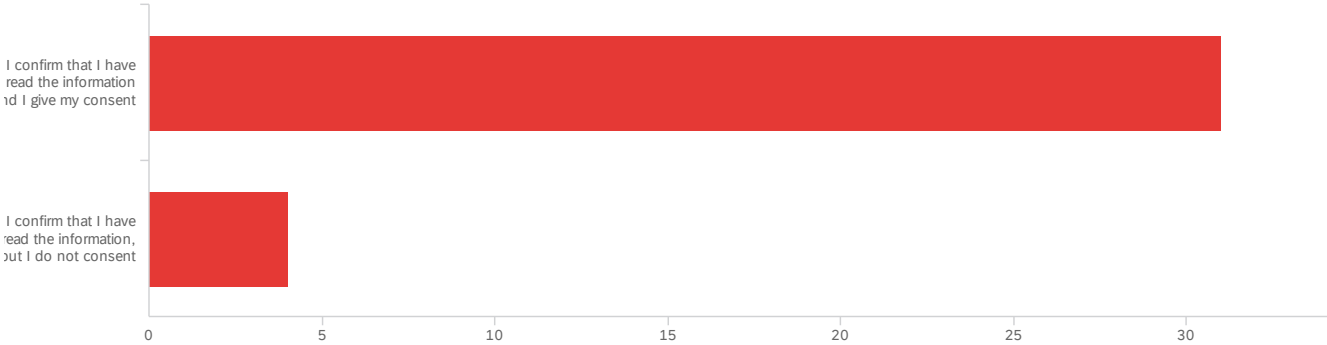
Default Report

MSc Aviation Survey

July 6, 2020 12:30 AM MDT

QID18 - INFORMATION FOR PARTICIPANTS General Aviation For the purpose of this research, General Aviation (GA) is considered to be all aviation activities that do not involve commercial gain, commonly referred to as "recreational flying". Background This survey forms part of an in-depth study of GA safety and accident causation, undertaken as part of a Safety and Accident Investigation MSc carried out through Cranfield University in the UK. The results of this survey will be analysed in conjunction with trends obtained from a review of 492 accident reports of events which occurred from January 1999 till December 2019 in the UK. Confidentiality All data provided is for research purposes only. It will be treated in strict confidence and remain anonymous. By giving your consent, you understand that Cranfield University will use the data you provide for research. The data (and any backups) will be stored in securely encrypted areas, only accessible by authorised users by the UK Data Protection Act 2018. Potential Benefits On completion of this research project, the results will be available from the University Thesis archive. It could be used to improve training and awareness of GA risks. Researcher's details Andre Roos Cranfield University School of Aerospace, Transport, and Manufacturing Safety and

Accident Investigation If you require any additional information or wish to discuss this survey the researcher can be contacted at a.m.roos@cranfield.ac.uk

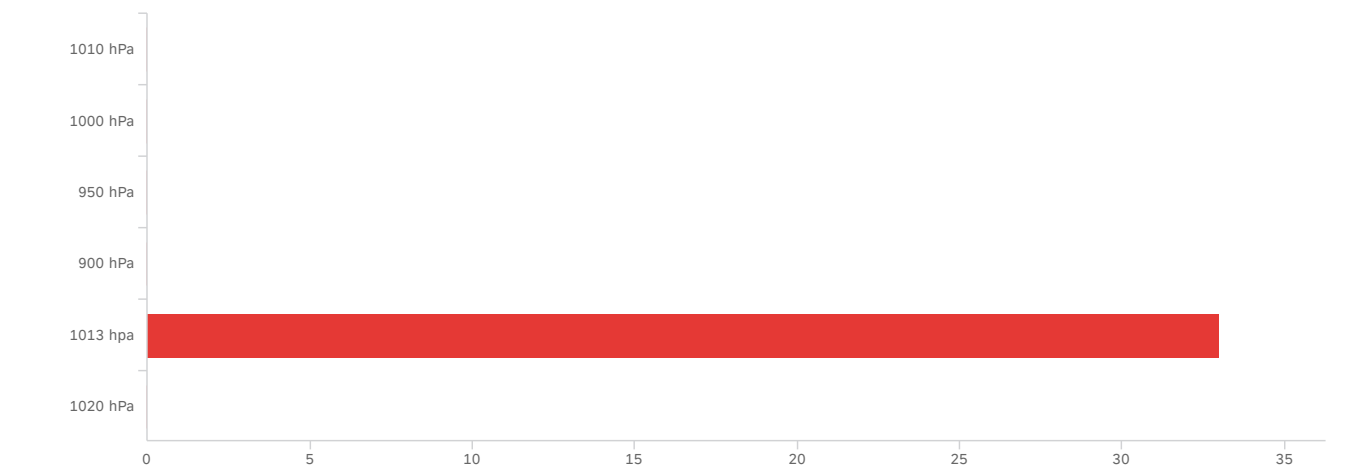


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	INFORMATION FOR PARTICIPANTS General Aviation For the purpose of this research, General Aviation (GA) is considered to be all aviation activities that do not involve commercial gain, commonly referred to as "recreational flying". Background This survey forms part of an in-depth study of GA safety and accident causation, undertaken as part of a Safety and Accident Investigation MSc carried out through Cranfield University in the UK. The results of this survey will be analysed in conjunction with trends obtained from a review of 492 accident reports of events which occurred from January 1999 till December 2019 in the UK. Confidentiality All data provided is for research purposes only. It will be treated in strict confidence and remain anonymous. By giving your consent, you understand that Cranfield University will use the data you provide for research. The data (and any backups) will be stored in securely encrypted areas, only accessible by authorised users by the UK Data Protection Act 2018. Potential Benefits On completion of this research project, the results will be available from the University Thesis archive. It could be used to improve training and awareness of GA risks. Researcher's details Andre Roos Cranfield University School of Aerospace, Transport, and Manufacturing Safety and Accident Investigation If you require any additional information or wish to discuss this survey the researcher can be contacted at a.m.roos@cranfield.ac.uk	1.00	2.00	1.11	0.32	0.10	35

#	Field	Choice Count
1	I confirm that I have read the information and I give my consent	88.57% 31
2	I confirm that I have read the information, but I do not consent	11.43% 4

35

Q2.1 - What is the standard ALT QNH for a Flight Level?

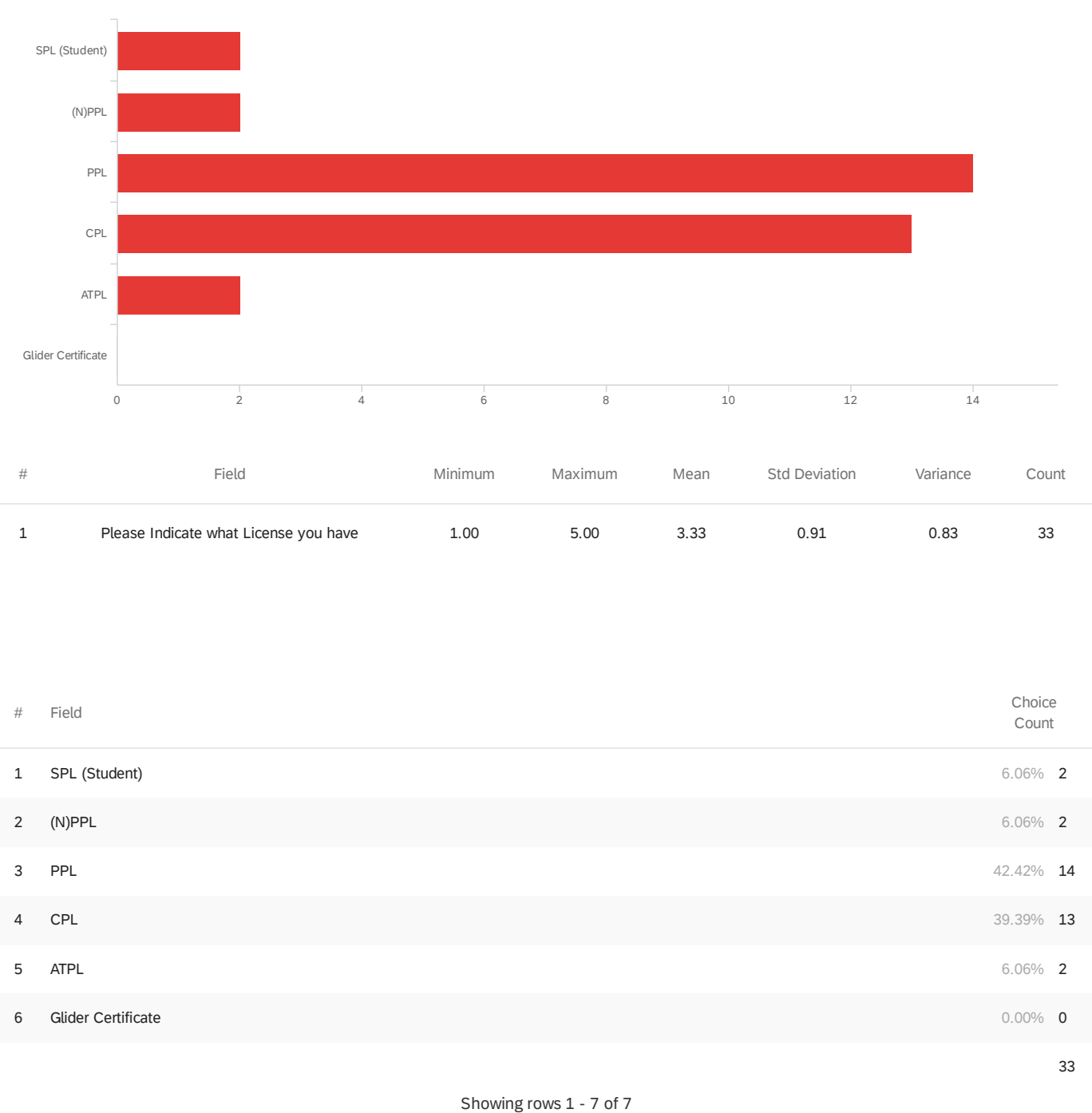


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	What is the standard ALT QNH for a Flight Level?	5.00	5.00	5.00	0.00	0.00	33

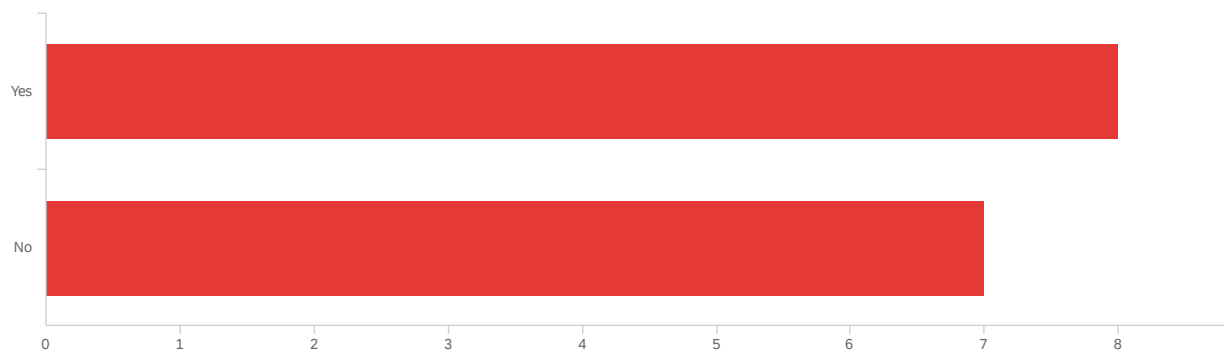
#	Field	Choice Count
1	1010 hPa	0.00% 0
2	1000 hPa	0.00% 0
3	950 hPa	0.00% 0
4	900 hPa	0.00% 0
5	1013 hpa	100.00% 33
6	1020 hPa	0.00% 0

33

Q3.1 - Please Indicate what License you have



Q3.2 - Do you participate in recreation flying apart from your commercial duties?



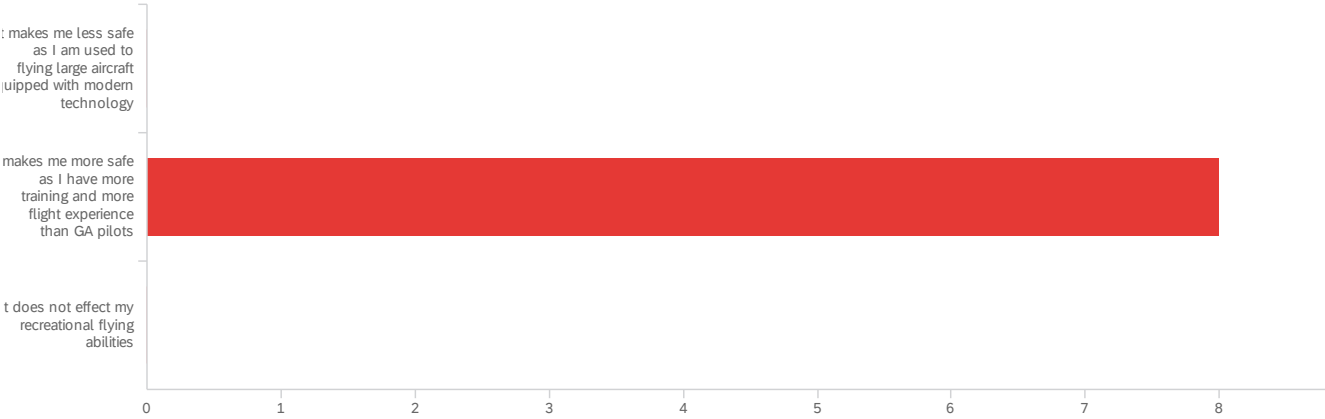
#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	Do you participate in recreation flying apart from your commercial duties?	1.00	2.00	1.47	0.50	0.25	15

#	Field	Choice Count
1	Yes	53.33% 8
2	No	46.67% 7

15

Showing rows 1 - 3 of 3

Q3.3 - How do you think being a Commercial Pilot effect your safety as a recreational pilot on small aircraft?

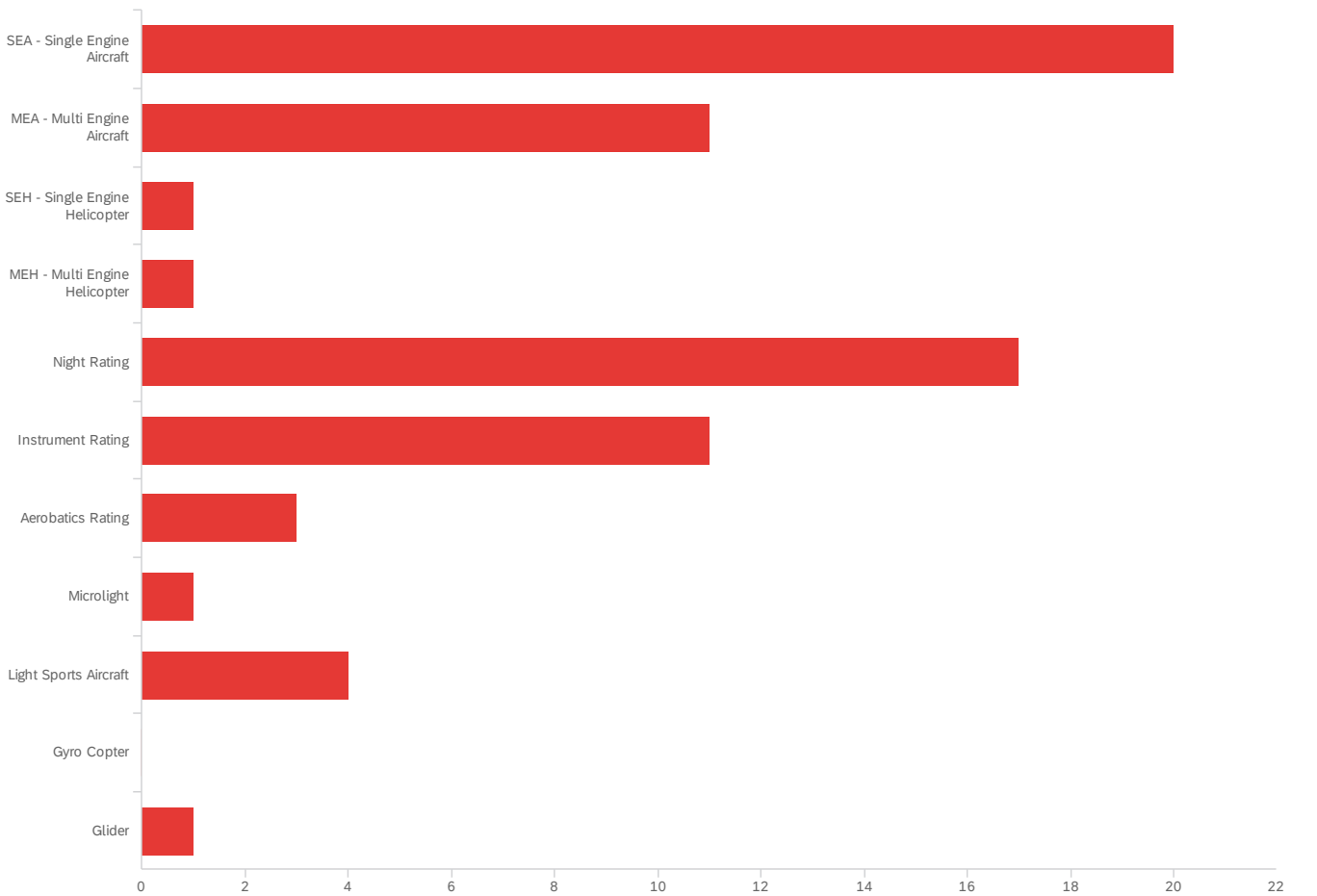


#	Field	Minimum	Maximum	Mean	Std Deviation	Variance	Count
1	How do you think being a Commercial Pilot effect your safety as a recreational pilot on small aircraft?	2.00	2.00	2.00	0.00	0.00	8

#	Field	Choice Count
1	It makes me less safe as I am used to flying large aircraft equipped with modern technology	0.00% 0
2	It makes me more safe as I have more training and more flight experience than GA pilots	100.00% 8
3	It does not effect my recreational flying abilities	0.00% 0
		8

Showing rows 1 - 4 of 4

Q3.4 - Please Indicate the ratings you have



#	Field	Choice Count
1	SEA - Single Engine Aircraft	28.57% 20
2	MEA - Multi Engine Aircraft	15.71% 11
3	SEH - Single Engine Helicopter	1.43% 1
4	MEH - Multi Engine Helicopter	1.43% 1
5	Night Rating	24.29% 17
6	Instrument Rating	15.71% 11
7	Aerobatics Rating	4.29% 3
8	Microlight	1.43% 1
9	Light Sports Aircraft	5.71% 4
10	Gyro Copter	0.00% 0

16:13



facebook.com



Andre Roos ▸ FlyAfrica

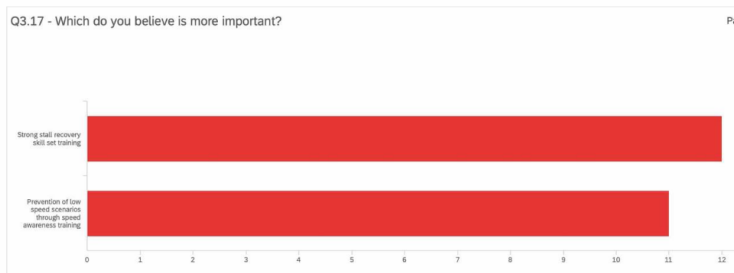
3 July at 15:52 · 🌐



Dear Aviators, debate time!

Following my survey the last 24 Hours (Thank you to those who completed it) this was the response on Stall Recovery training versus Speed Awareness training.

Personally, I believe it is more important to be aware of your speeds to avoid stalls. Please can I ask some comments on this? All in the name of safety please.



Like



Share

You turned off commenting for this post.



3



Richard Whiteley

Top comment. 👍



5 mths Like More



Helene Lientjie Brink

Altitude determines whether you can successfully recover from a stall. If you're low, it won't happen. Therefore I agree on the speed awareness. High or low...



5 mths Like More



Dale De Klerk

Helene Lientjie Brink stall has nothing to do with speed



5 mths Like More



Helene Lientjie Brink

Dale De Klerk Please help me understand? I lost my fiancée years ago and he said he stalled. I thought that it is low and slow that was the problem?



Glenn Scott

Helene Lientjie Brink once any aircraft exceeds its critical angle of attack it will stall at any speed. But yes this is achieved more frequently a low speed but again it could be at any speed particularly when close to coffin corner at high altitude, google that.



5 mths Like More



Helene Lientjie Brink

Glenn Scott thankyou!

5 mths Like More



Dale De Klerk

Helene Lientjie Brink to fully understand it, I would need to give you a lecture. The bottom line is that an aircraft stall is determined by angel of attack. This can also change during a turn and by pulling more G forces. That is why it is imperative to teach a student how to recover correctly. As it is possible to inadvertently get into a stall

5 mths Like More



Helene Lientjie Brink

Dale De Klerk thankyou !

5 mths Like More



Robert Earle

Speed awareness aside ... U can have 500 hrs training just on stall/spin recovery. But if u don't have sufficient height, ure a goner - period!

An airliner in full stall, requires about 20000ft to recover - provided no catastrophic structural damage occurs.

With a Pappa Charlie, a stall/spin recovery with lots of height available, is a breeze (if uve been trained properly, have confidence & practiced it)

At very high altitudes & high speed V stall, 'coffin corner' is the main factor. As little as 5 Kts can cause ure plane to experience an immediate catastrophic structural failure, when even the slighest attempt at turning, can cause one wing to stall & the other wing to brake the sound barrier, wich will result in the above disastrous reality. In a nutshell!

16:13 ↗



facebook.com

Bit more complicated & too much to describe now. Air density & viscosity come into play here
BIG TIME!

But the two really go hand-in-hand !!

5 mths Like More



Dale De Klerk

Robert Earle that is why it is so important to recognize the symptoms of a pending stall. Especially in GA

5 mths Like More



Robert Earle

Dale De Klerk

Fully agree - ESPECIALLY at a low height!  1

5 mths Like More



Alex van Oostveen

I believe stall recovery training is better to have. If the aircraft type allows it, the stall can be perceived and treated as a flyable condition. Doing so takes the panic and subsequent poor decision making and handling out of stall conditions. I think stall recovery training inherently includes a good enough degree of speed awareness training.



5 mths Like More



Glenn Scott replied · 1 reply



Casey Wolters

I disagree with you. Stalling is a function of angle of attack, not speed. A wing stalls beyond a certain angle of attack, and that AoA can be reached at various speeds depending on the load factor (g). The basic stall speed is for 1g, but for eg if you increase the load factor to 4g you double the speed at which the wing stalls. The stall symptoms a pilot will experience will remain roughly the same at all speeds and load factors, there I content that stall recovery training trumps speed awareness training. However, speed awareness training is important during the low speed handling phases of flight.



5 mths Like More



16:14



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5 mths Like More



R.D. Kuch

Speed has nothing to do with stall.. 🤔😬 2

5 mths Like More



Megan Stevenson

Absolutely agree with you **Alex van Oostveen**. We all loose concentration at times. Recovery is everything.



5 mths Like More



You replied · 1 reply



Quintin Cairncross

I assume this refers to the air transport scenario. If so, the answer is BOTH. I doubt there are many pilots in air transport operations who actually intended to stall their aircraft with passengers or freight on board. The thing is that it usually takes the crew by surprise. There is startle effect and usually fatigue, low state of mental arousal, confusion, distraction and all the associated factors which reduce human performance. So we need to train crews to recognize and avoid situations and scenarios where they can stray into the low energy corner of the flight envelope. Similarly, it is equally important to train them to recover if they do miss the cues associated with an impending stall. (and yes, it can happen at any speed). This training is incredibly difficult as one cannot simulate the fatigue and low mental arousal state. We all do it every year in the simulator - "look down, I will take control and put the aircraft into an unusual attitude/energy state. When I say look up, you take control and recover..." Those with access to UPRT in an aerobatic type no doubt benefit further, but not everyone has access to this type of training. It's not ideal, but UPRT in a simulator is what most of us get. Until something better comes along, the answer is definitely both.



5 mths Like More



Andre Roos

The option of "Both" was intentionally left out. To force the participants to chose one above the other.

5 mths Like More



Andre Roos

ID	Date	Engines	Type	Injuries	Age	License	TT	90 Days	28 Days	TT on Type	Aircraft Type	Phase of Flight	CTCC
EW/C2019/10/02	27/10/2019	1	Private	Minor	57	NPL	267	6	4	28	Fixed wing	Landing	CTOL
EW/C2019/04/04	08/04/2019	1	Private	None	69	PPL	632	10	5	235	Fixed wing	Landing	ARC
EW/C2019/07/04	22/07/2019	1	Private	None	21	PPL-H	174	22	9	110	Rotorwing	Standing	F-NI
EW/C2019/09/05	15/09/2019	1	Private	None	61	ATPL	10300	14	8	160	Fixed wing	Landing	SCF-NP
EW/C2019/05/01	04/05/2019	0	Private	Fatal	64	Gliding Cert	3349	30	17		Glider	En route	OTHR
EW/C2019/06/04	22/06/2019	1	Private	Serious	87	NPL	363	0	0	289	Fixed wing	Taxi	LOC-G
EW/C2018/08/02	01/08/2018	1	Private	None	46	PPL-H	220	18	4	100	Rotorwing	En route	SCF-PP
EW/C2018/06/03	08/06/2018	1	Training	Serious	59	CPL-H	8920	30	7	69	Rotorwing	Landing	LOC-I
EW/C2019/02/01	03/02/2019	1	Private	Fatal	55	PPL	317			150	Fixed wing	Take-off	LOC-I
EW/C2018/10/02	10/10/2018	1	Private	Fatal	76	PPL	586	8	3	546	Fixed wing	Approach	LOC-I
EW/C2018/06/02	13/06/2018	1	SpI-Ops	Fatal	59	ATPL-H	9260	127	37	1892	Rotorwing	En route	LOC-I
EW/C2018/07/02	12/07/2018	1	Private	Serious	69	PPL	316	5	3	31	Fixed wing	Take-off	SCF-PP
EW/C2018/06/01	10/06/2018	1	Training	Fatal	68	PPL	550	7	2	27	Fixed wing	Landing	CTOL
EW/C2018/07/03	18/07/2018	1	Private	Fatal	33	PPL	343	19	17	17	Fixed wing	Take-off	LOC-I
EW/C2018/10/05	07/10/2018	1	Private	None	75	PPL	1048	8	3	350	Fixed wing	Landing	SCF-NP
EW/C2018/04/02	30/04/2018	1	Private	Minor	36	CPL	878	0	0	748	Fixed wing	Landing	LOC-I
EW/C2018/05/02	30/05/2018	1	Private	Fatal	70	PPL-H	255	0.5	0	224	Rotorwing	En route	LOC-I
EW/C2018/04/01	19/04/2018	1	Private	Fatal	77	PPL	18383	5	4	900	Fixed wing	En route	LOC-I
EW/C2017/12/04	23/12/2017	1	Private	Fatal	44	PPL	1398			342	Fixed wing	Take-off	SCF-PP
EW/C2018/07/01	07/07/2018	1	Private	Serious	80	PPL	641	5	2	465	Fixed wing	Approach	FUEL
EW/C2017/07/01	13/07/2017	1	Training	Fatal	57	ATPL	18200	266	40		Fixed wing	En route	LOC-I
EW/C2018/01/03	08/01/2018	1	Training	Fatal	52	CPL	5700	131	18		Fixed wing	En route	CHT
EW/C2017/12/01	09/12/2017	1	Training	Fatal	58	SPL	39	10	4	28	Fixed wing	Take-off	LOC-I
EW/C2017/11/02	17/11/2017	1	Training	Fatal	27	CPL	419		19	400	Fixed wing	En route	MAC
EW/C2017/11/02	17/11/2017	1	Training	Fatal	74	ATPL-H	25000				Rotorwing	En route	MAC
EW/C2017/05/01	05/05/2017	1	Training	Fatal	45	CPL-H	5747	53	17	579	Rotorwing	Landing	LOC-I
EW/C2017/08/01	10/08/2017	1	Private	None	55	Gliding Cert	314	9	7	25	Motorized Glider	Landing	F-NI
EW/C2017/09/03	11/09/2017	1	Private	Fatal	58	PPL	1129	15	10	406	Fixed wing	En route	SCF-PP
EW/C2017/05/03	25/05/2017	1	Private	Fatal	62	PPL	219	8	5	38	Fixed wing	En route	CHT
EW/C2017/05/02	14/05/2017	1	Aerobatics	Serious	49	PPL	1154	15	13	259	Fixed wing	En route	SCF-PP
EW/C2017/09/06	28/09/2017	1	Private	None	55	NPL	546	12	1	48	Fixed wing	Landing	LOC-G
EW/C2017/08/02	01/08/2017	1	Private	None	79	NPL	469	1	1	347	Fixed wing	Landing	SCF-NP
EW/C2017/06/02	20/06/2017	1	Private	Fatal	71	PPL	5215	0	0	342	Fixed wing	Take-off	LOC-I
EW/C2017/04/01	08/04/2017	0	Private	Fatal	62	PPL	18800	1	0	39	Glider	Take-off	LOC-I
EW/C2016/12/02	04/12/2016	0	Private	Fatal	47	Gliding Cert	1500				Glider	Take-off	LOC-I
EW/C2016/09/01	18/09/2016	1	Private	Fatal	55	NPL	316	58	22	316	Fixed wing	En route	LOC-I
EW/C2017/05/04	28/05/2017	1	Private	Fatal	79	NPL	1146	7	1	880	Fixed wing	Take-off	SCF-PP
EW/C2016/07/01	08/07/2016	1	Aerobatics	Fatal	60	CPL	2953	18	15	446	Fixed wing	En route	SCF-PP
EW/C2017/01/01	15/01/2017	2	Private	Fatal	64	PPL	10673	3	0	2140	Fixed wing	En route	CHT
EW/C2016/12/01	04/12/2016	0	Private	Fatal	70	Gliding Cert	1054	12	4	1048	Glider	En route	MAC
EW/C2016/12/01	04/12/2016	1	Training	None	26	CPL	1124	112	26	815	Fixed wing	En route	MAC
EW/C2016/10/03	17/10/2016	1	Private	Fatal	58	PPL	363	7	2	9	Fixed wing	Take-off	LOC-I

EW/C2016/08/03	14/08/2016	1	Aerobatics	Minor	71	PPL	922	8	2	360	Fixed wing	En route	SCF-PP
EW/C2016/05/01	30/05/2016	1	Private	Fatal	64	NPL	185	13	10	8	Fixed wing	Approach	LOC-I
EW/C2016/07/04	17/07/2016	1	Private	Fatal	36	PPL-H	708	18	8	164	Rotorwing	En route	LALT
EW/C2016/08/01	02/08/2016	1	Private	Serious	63	NPL	2500	30	15	1200	Fixed wing	En route	LOC-I
EW/C2016/03/01	20/03/2016	1	Private	Fatal	61	NPL	117	2.5	1.5	17	Fixed wing	Landing	CTOL
EW/C2016/07/08	19/07/2016	1	Private	None	61	PPL	2642	26	13	1651	Fixed wing	Landing	SCF-NP
EW/C2016/04/02	30/04/2016	1	Aerobatics	Fatal	25	PPL	215	34	14	3	Fixed wing	En route	LOC-I
EW/C2016/07/06	18/07/2016	1	Private	Minor	61	ATPL	19162	38	22	30	Fixed wing	Take-off	GCOL
EW/C2016/07/05	28/07/2016	1	Training	Fatal	79	SPL	1650	35	8	41	Gyro	Landing	LOC-I
EW/C2016/07/03	21/07/2016	1	Private	Fatal	60	Gliding Cert	1800	16	0	3	Motorized Glider	En route	LOC-I
EW/C2016/07/07	16/07/2016	1	Private	None	42		269	26	21	38	Fixed wing	Taxi	SCF-NP
EW/C2016/06/01	09/06/2016	1	Private	Fatal	68	NPL					Fixed wing	En route	SCF-NP
EW/C2016/02/02	27/02/2016	1	Training	Serious	41	SPL	39	4	2	39	Fixed wing	Take-off	LOC-I
EW/C2015/11/01	14/11/2015	1	Private	Fatal	56	PPL	600	17	4	260	Fixed wing	Approach	LOC-I
EW/C2015/08/03	17/08/2015	2	Private	Fatal	68	PPL	1300	16	16	16	Fixed wing	Landing	ARC
EW/C2015/10/03	31/10/2015	1	Private	Fatal	71	NPL	242	17	4	2	Microlight	En route	LALT
EW/C2015/10/02	19/10/2015	1	Private	Serious	66	NPL	154	11	1	0	Fixed wing	Take-off	LOC-I
EW/C2015/12/01	03/12/2015	1	Private	Fatal	73	PPL	200			100	Fixed wing	En route	LOC-I
EW/C2015/09/01	04/09/2015	1	Training	Fatal	39	SPL	33	33	10	33	Fixed wing	Take-off	LOC-I
EW/C2015/06/01	06/06/2015	1	Private	Fatal	48	PPL-H	786	6	6	71	Rotorwing	En route	SCF-NP
EW/C2015/01/02	03/01/2015	1	Private	Fatal	50	PPL	201	7	2	5	Fixed wing	Approach	SCF-PP
EW/C2015/09/02	06/09/2015	1	Private	None	54	Gliding Cert	2500	58	30	300	Motorized Glider	En route	SCF-PP
EW/C2015/04/02	07/04/2015	1	Private	Fatal	55		89	4	1	23	Fixed wing	Take-off	LOC-I
EW/C2014/06/05	27/06/2014	1	Private	None	44	PPL-H	850	32	12.5	500	Rotorwing	En route	LOC-I
EW/C2015/04/03	22/04/2015	1	Aerobatics	Fatal	61	PPL	1290	4	4	265	Fixed wing	En route	LOC-I
EW/C2015/07/01	03/07/2015	1	Private	Fatal	62	NPL	213	2	2	163	Microlight	Landing	CTOL
EW/C2014/09/02	16/09/2014	1	Spl-Ops	Fatal	58	CPL-H	4000				Rotorwing	En route	SCF-PP
EW/C2015/04/01	04/04/2015	1	Private	Fatal	28	PPL	150	62	19	100	Fixed wing	En route	LOC-I
EW/C2015/04/06	15/04/2015	1	Private	None	55	PPL	800	6	6	150	Fixed wing	Approach	SCF-PP
EW/C2014/08/01	09/08/2014	1	Private	Fatal	53	NPL	555	29	1	100	Fixed wing	Take-off	SCF-PP
EW/C2014/07/01	25/07/2014	1	Private	None	55	CPL	1877	64	21	1	Fixed wing	Landing	SCF-NP
EW/C2014/06/02	18/06/2014	0	Private	Fatal	73	Gliding Cert	12000	24	12	11	Glider	En route	LOC-I
EW/C2014/08/03	20/08/2014	1	Private	Fatal	60		3027	28	13	80	Fixed wing	En route	LOC-I
EW/C2014/06/01	14/06/2014	1	Private	Fatal	70	PPL	293	4	2	240	Fixed wing	Take-off	SCF-PP
EW/C2014/03/04	29/03/2014	1	Aerobatics	Fatal	50	ATPL	15000	1	1	40	Fixed wing	Unknown	LOC-I
EW/C2014/09/03	23/09/2014	1	Private	Fatal	46	PPL	990	36	4	200	Fixed wing	En route	MAC
EW/C2014/09/03	23/09/2014	1	Private	None	56	PPL	1038	11	7	604	Fixed wing	En route	MAC
EW/C2014/05/02	17/05/2014	1	Private	Minor	63	PPL	517	9	5	156	Fixed wing	Unknown	SCF-NP
EW/C2014/05/01	15/05/2014	1	Private	Fatal	61	SPL	26	5	2	10	Fixed wing	Take-off	LOC-I
EW/C2014/04/02	18/04/2014	1	Private	Fatal	50	NPL	162	2	2	100	Fixed wing	Approach	LOC-I
EW/C2013/11/03	15/11/2013	2	Private	Fatal	58	CPL	1645	18	6	261	Fixed wing	Approach	FUEL
EW/C2013/10/01	06/10/2013	1	Private	Fatal	52	None	73	2	1	59	Microlight	Approach	CTOL
EW/C2013/10/02	04/10/2013	1	Private	Minor	61	ATPL-H	445	21	9	18	Rotorwing	En route	SCF-PP

EW/C2013/09/02	30/09/2013	1	Private	Fatal	66	PPL	332	9.5	3	34	Fixed wing	En route	CFIT
EW/C2013/08/04	28/08/2013	1	Private	Fatal	57	NPL	63	9	3	4	Fixed wing	Take-off	SCF-PP
EW/C2013/08/02	21/08/2013	1	Private	Fatal	56	NPL	460	20	1	104	Fixed wing	Approach	LOC-I
EW/C2013/07/03	21/07/2013	1	Private	Fatal	36	PPL	192	2	2	76	Fixed wing	En route	LOC-I
EW/C2013/07/02	14/07/2013	1	Private	Fatal	76	NPL	365	7	4	305	Fixed wing	Approach	LOC-I
EW/G2013/06/17	19/06/2013	1	Private	Serious	59	PPL	224	10	8	8	Rotorwing	Approach	SCF-NP
EW/C2013/06/01	05/06/2013	1	Training	Serious	21	CPL	390	77	15	145	Fixed wing	Take-off	SCF-PP
EW/C2013/05/01	19/05/2013	1	Private	Fatal	61	PPL	90	9	2	72	Fixed wing	Approach	CTOL
EW/C2013/04/02	27/04/2013	1	Aerobatics	Fatal	68	PPL	1903	3	2	10	Fixed wing	En route	LOC-I
EW/C2012/12/01	08/12/2012	1	Private	Fatal	56	PPL	634	6	2	260	Fixed wing	En route	CFIT
EW/C2012/09/01	04/09/2012	0	Private	Fatal	49	Gliding Cert	1325	1	1	100	Glider	Take-off	LOC-I
EW/C2012/08/08	26/08/2012	1	Private	None	56	CPL	6500	28	19	40	Fixed wing	Landing	SCF-NP
EW/C2012/08/05	22/08/2012	1	Private	Fatal	79	NPL	164	2	1	164	Fixed wing	En route	LOC-I
EW/C2012/08/03	16/08/2012	1	Training	Fatal	50	CPL	10440	135	45	150	Fixed wing	En route	LOC-I
EW/C2012/08/01	12/08/2012	1	Private	None	49	NPL	377	26	8	300	Fixed wing	Landing	SCF-NP
EW/C2012/07/06	04/08/2012	0	Private	Fatal	59	Gliding Cert	28	2	1	5	Glider	En route	LOC-I
EW/C2012/07/01	21/07/2012	1	Training	None	26	ATPL	840	158	47	642	Fixed wing	Take-off	SCF-PP
EW/C2012/07/03	01/07/2012	1	Aerobatics	Fatal	52	ATPL	14780	151	56	55	Fixed wing	En route	LOC-I
EW/C2012/05/03	18/05/2012	1	Private	Serious	62	PPL	363	2	0	0	Microlight	En route	LALT
EW/C2012/05/02	12/05/2012	1	Private	Fatal	63	PPL	826	12	6	1	Microlight	En route	CFIT
EW/C2012/04/08	30/04/2012	0	Private	Fatal	65	Gliding Cert	274	17	8	10	Glider	En route	LOC-I
EW/C2012/04/01	12/04/2012	1	Private	Fatal	49	None	0	0	0	0	Microlight	Take-off	LOC-I
EW/C2012/03/06	25/03/2012	1	Training	None	79	CPL	21760	40	16	5000	Fixed wing	Landing	SCF-NP
EW/C2012/01/01	06/01/2012	1	Private	Fatal	50	PPL	59	18	12	59	Rotorwing	En route	LOC-I
EW/C2011/12/01	18/12/2011	1	Private	Fatal	55	PPL	640	15	1	150	Fixed wing	Approach	MAC
EW/C2011/12/01	18/12/2011	1	Private	None	48	NPL	948	21	4	150	Fixed wing	Approach	MAC
EW/C2011/12/02	16/12/2011	2	Private	None	44	PPL	374	31	13	12	Fixed wing	Approach	SCF-PP
EW/C2011/11/01	12/11/2011	1	Private	Fatal	79	NPL	150	33	1.2	150	Fixed wing	En route	SCF-NP
EW/C2011/09/04	01/09/2011	1	Private	None	62	PPL	21500	67	25	560	Fixed wing	Landing	ARC
EW/C2011/07/05	29/07/2011	1	Private	Fatal	59	PPL	426	3	1	302	Fixed wing	Take-off	SCF-PP
EW/C2011/07/27	27/07/2011	1	Private	None	21	PPL	86	3	3	15	Fixed wing	En route	F-NI
EW/C2011/04/01	24/07/2011	1	Private	Fatal	45	PPL-H	285	6	7	221	Rotorwing	En route	LOC-I
EW/C2011/07/08	17/07/2011	1	Private	None	55	PPL	394	14			Fixed wing	Standing	SCF-NP
EW/C2011/07/01	04/07/2011	1	Private	Fatal	62	PPL	20600				Fixed wing	Approach	MAC
EW/C2011/07/01	04/07/2011	1	Private	None	60	ATPL	3450	35	13	32	Fixed wing	Approach	MAC
EW/C2011/06/05	27/06/2011	1	Private	None	47	PPL	380	38	7	88	Gyro	Take-off	CTOL
EW/C2011/06/04	26/06/2011	1	Private	Serious	52	NPL	385	9	4	4	Fixed wing	Approach	LOC-I
EW/C2011/06/06	25/06/2011	1	Private	None	36	PPL	2225	58	11	31	Fixed wing	Take-off	SCF-PP
EW/C2011/06/03	19/06/2011	1	Private	Serious	57	PPL-H	730	20	10	720	Rotorwing	En route	SCF-NP
EW/C2011/06/01	03/06/2011	1	Private	Minor	32	PPL	195	14	14	57	Fixed wing	Take-off	CTOL
EW/C2011/05/02	15/05/2011	1	Aerobatics	Fatal	44	PPL	210	3	2	41	Fixed wing	Unknown	LOC-I
EW/C2011/05/01	05/05/2011	1	Private	Fatal	63	NPL	591	11	6	93	Fixed wing	Approach	CTOL
EW/C2011/04/02	28/04/2011	1	Private	Fatal	51	PPL	128	20	7	25	Gyro	Unknown	SCF-NP

1 :

Visible: 16 of 16 Variables

	Engines	Type	Injuries	Age	License	TT	@90Days	@28Days	TTonType	AircraftType	PhaseofFlight	CITCC	AgeGroups	TTGroups	TT90
1	1	Private	None/Minor	57	NPL	267.00	6.00	4.00	28.00	Microlight	Landing	CTOL	51-60	51-350	<10
2	1	Private	None/Minor	69	PPL	632.00	10.00	5.00	235.00	Fixed Wing	Landing	ARC	61-70	351-650	<10
3	1	Private	None/Minor	21	PPL	174.00	22.00	9.00	110.00	Rotor Wing	Standing	F-NI	21-30	51-350	21-30
4	1	Private	None/Minor	61	ATPL	10300.00	14.00	8.00	160.00	Fixed Wing	Landing	SCF-NP	61-70	>3050	11-20
5	0	Private	Fatal	64	Glider Cert	3349.00	30.00	17.00	.	Glider	En Route/Maneuver...	OTHR	61-70	>3050	21-30
6	1	Private	Serious	87	NPL	363.00	.00	.00	289.00	Fixed Wing	Taxi	LOG-G	>80	351-650	<10
7	1	Private	None/Minor	46	PPL	220.00	18.00	4.00	100.00	Rotor Wing	En Route/Maneuver...	SCF-PP	41-50	51-350	11-20
8	1	Private	Fatal	55	PPL	317.00	.	.	150.00	Fixed Wing	Take Off	LOC-I	51-60	51-350	.
9	1	Private	Fatal	76	PPL	586.00	8.00	3.00	546.00	Fixed Wing	Approach	LOC-I	71-80	351-650	<10
10	1	Private	Fatal	59	ATPL	9260.00	127.00	37.00	1892.00	Rotor Wing	En Route/Maneuver...	LOC-I	51-60	>3050	>100
11	1	Private	Serious	69	PPL	316.00	5.00	3.00	31.00	Fixed Wing	Take Off	SCF-PP	61-70	51-350	<10
12	1	Private	Fatal	33	PPL	343.00	19.00	17.00	17.00	Fixed Wing	Take Off	LOC-I	31-40	51-350	11-20
13	1	Private	None/Minor	75	PPL	1048.00	8.00	3.00	350.00	Fixed Wing	Landing	SCF-NP	71-80	951-1250	<10
14	1	Private	None/Minor	36	CPL	878.00	.00	.00	748.00	Fixed Wing	Landing	LOC-I	31-40	651-950	<10
15	1	Private	Fatal	70	PPL	255.00	.50	.00	224.00	Rotor Wing	En Route/Maneuver...	LOC-I	61-70	51-350	<10
16	1	Private	Fatal	77	PPL	18383.00	5.00	4.00	900.00	Fixed Wing	En Route/Maneuver...	LOC-I	71-80	>3050	<10
17	1	Private	Fatal	44	PPL	1398.00	.	.	342.00	Fixed Wing	Take Off	SCF-PP	41-50	1251-1550	.
18	1	Private	Serious	80	PPL	641.00	5.00	2.00	465.00	Fixed Wing	Approach	FUEL	71-80	351-650	<10
19	1	Private	None/Minor	55	Glider Cert	314.00	9.00	7.00	25.00	Glider	Landing	F-NI	51-60	51-350	<10
20	1	Private	Fatal	58	PPL	1129.00	15.00	10.00	406.00	Fixed Wing	En Route/Maneuver...	SCF-PP	51-60	951-1250	11-20
21	1	Private	Fatal	62	PPL	219.00	8.00	5.00	38.00	Fixed Wing	En Route/Maneuver...	CFIT	61-70	51-350	<10
22	1	Private	Fatal	55	NPL	546.00	12.00	1.00	48.00	Fixed Wing	Landing	LOG-G	51-60	351-650	11-20
23	1	Private	None/Minor	79	NPL	469.00	1.00	1.00	347.00	Fixed Wing	Landing	SCF-NP	71-80	351-650	<10
24	1	Private	Fatal	71	PPL	5215.00	.00	.00	342.00	Fixed Wing	Take Off	LOC-I	71-80	>3050	<10
25	0	Private	Fatal	62	PPL	18800.00	1.00	.00	39.00	Glider	Take Off	LOC-I	61-70	>3050	<10
26	0	Private	Fatal	47	Glider Cert	1500.00	.	.	.	Glider	Take Off	LOC-I	41-50	1251-1550	.
27	1	Private	Fatal	55	NPL	316.00	58.00	22.00	316.00	Fixed Wing	En Route/Maneuver...	LOC-I	51-60	51-350	51-60
28	1	Private	Fatal	79	NPL	1146.00	7.00	1.00	880.00	Fixed Wing	Take Off	SCF-PP	71-80	951-1250	<10
29	2	Private	Fatal	64	PPL	10673.00	3.00	.00	2140.00	Fixed Wing	En Route/Maneuver...	CFIT	61-70	>3050	<10

Data View Variable View

IBM SPSS Statistics Processor is ready

Unicode:ON



Informed Consent Form

General Aviation Safety Interview with special focus of Loss of Control and Upset Recovery training. Research population: GA Pilots and Instructors – South Africa, United Kingdom

This interview for part of an in-debt study of GA safety and accidents/incidents causation in South Africa and the United Kingdom. The study is undertaken as part of a Safety and Accident Investigation MSc carried out through Cranfield University in the UK.

The results of the interview will be analysed in conjunction with trends obtained from a review of publicly available Accident Investigation reports during the following time periods:

South Africa: 1 August 2007 – 31 December 2018 (491 Reports)

United Kingdom: 1 January 2009 – 31 December 2019 (492 Reports)

Title of the project:	MSc Research on GA Safety and LOC-I
Name of the researcher:	Andries Roos, s312696
Researcher's contact details:	a.m.roos@cranfield.ac.uk , +27824256226
Participant number:	
Date:	5/8/2020 15:48:20 PM SAST

Request consent to participate and note the ability to withdraw.

1. I confirm that I have been informed about this research project and I agree to take part.
2. I understand that all personal information I provide will be treated with confidence and my name will not be used in any report, publication or presentation.
3. I have been provided with a participant number as shown above. The researcher(s) will record data against my participant number instead of recording my name. The file linking my name to my participant number will be accessible only to the main researcher(s) and will be securely destroyed after 12 months.
4. I understand that I can withdraw from this project at any stage by informing a member of the research team, for whom contact details have been provided. I also understand that I can withdraw my data for a period of up to 30 days from today, as after this time it will not be possible to identify my individual data from the aggregated results as explained in point 3.
5. I understand that the data I provide will be used by Cranfield University for the purpose of research. The data will be stored on the University's network that can only be accessed by authorised users, in line with UK Data Protection Act 2018.
6. Interviews will be recorded and securely stored on the Cranfield University network as audio files. These audio files will be securely deleted as soon as they are no longer required.
7. The recordings will be transcribed and saved as text files. These files (and any backups) will also be securely deleted as soon as they are no longer required.
8. Anonymised transcripts will be created, by removing or replacing identifiers such as name, age, and location. These anonymised transcripts may be quoted from or published in full, in support of findings (e.g. in journal articles, conference papers).
9. I understand that the aggregated data will be published in support of the research findings.
10. Analytical software will be used to aggregate the results of the research and every reasonable step will be taken to anonymise the data.
11. I will respect the confidentiality of the others taking part in the interviews by not discussing comments made outside of the room.

I confirm that I have read and understand the information provided on this form and give my consent to taking part in this research.

Participant's signature:	<i>Dan Gryder</i>	Date:	5/8/2020 15:48:20 PM SAST
Participant's name:	dan gryder		
Researcher's signature:		Date:	



General Aviation Safety semi-structured interview plan

Interviewees – GA Pilots, GA Flight Instructors, Maintenance Engineers and Commercial Pilots

Goal: 12 Interviews

Interview objective

To record the interviewees perception of:

- Risks associated with Loss of Control
- Upset recovery training
- Speed awareness training
- General Aviation safety
- Interpretation of data-based findings

Demographics

Name

Pilot or Instructor?

Years of flying experience?

Total Time?

Notes

- Mention important findings from the data, then allow interviewee free narrative.
- Do not lead the interviewee.
- Remind the interviewee of anonymity and that the interview and research aim is to improve General Aviation safety.
- Set time limit of 30min to interview and inform interviewee.
- Show interviewee findings graphs.

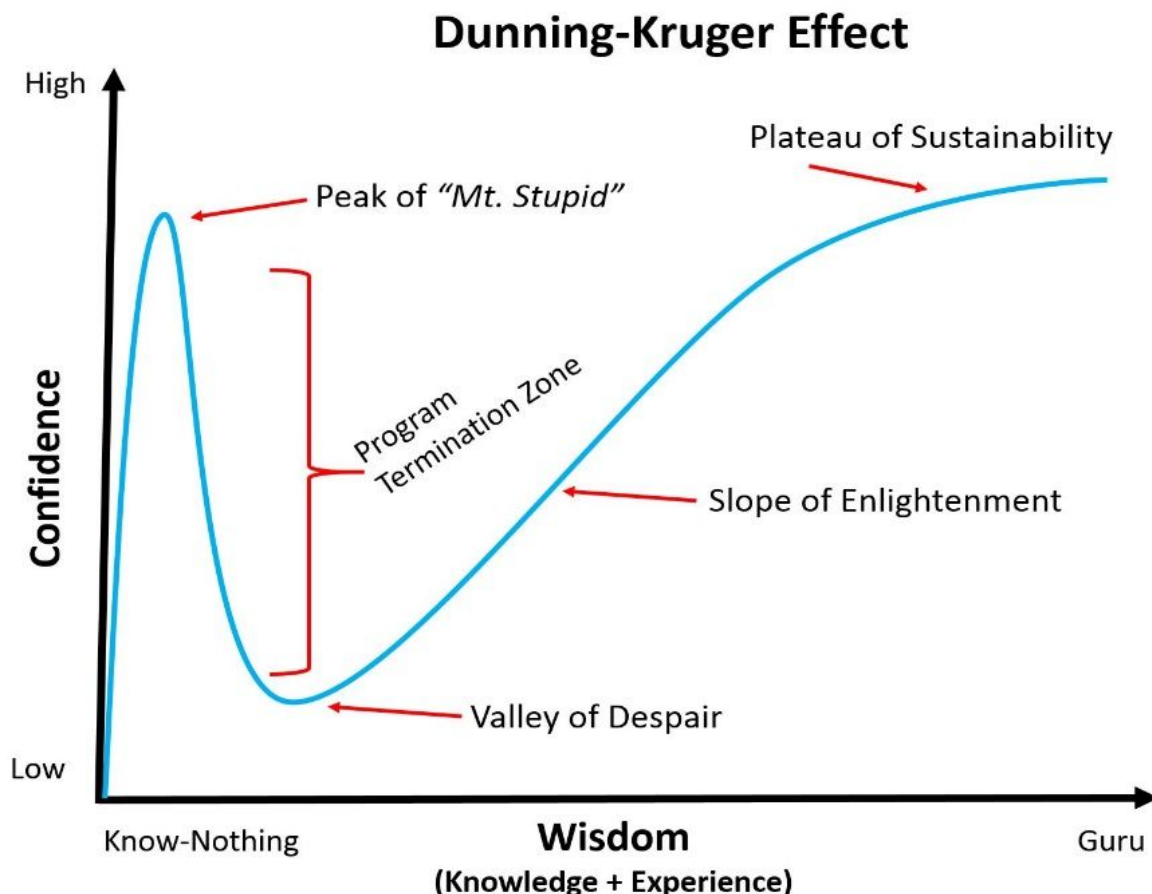
Findings to discuss

- CITCC responsible for most fatalities
- LOC-I mostly happening in traffic pattern
- Direct relation between TT and Injuries
- NO relation between TT on Type and Injuries
- Mean TT between 1500 and 2200 hours
- Killing zone? What do interviewee think about it?
- EFATO Stalls.
- Interviewees ability to recover from inflight upset.
- Fatality rate on aircraft type/license type.
- UK vs SA data?

Questions

1. What do you think is the biggest cause of fatal accidents in GA
 - 1.1 Why (answer 1)
 - 1.2 Why (answer 1.1)
 - 1.3 What do you think can be done to avoid it?
2. Which part of the traffic pattern do you consider the most dangerous?
 - 2.1 Why (answer 2)
 - 2.2 Why (answer 2.1)
 - 2.3 What do you think can be done to improve awareness?
3. How competent do you think GA pilots is in speed awareness and upset recovery
 - 3.1 Why (answer 3)
 - 3.2 Why (answer 3.1)
 - 3.3 What do you think can be done to improve skills?
4. Do you believe in the "Killing Zone"
 - 4.1 Why (answer 4)
 - 4.2 Where do you think it is?
5. Do you know what the Dunning Kruger effect is?
6. How important do you think TT, 90 Days and TToT is for safety? Currency?
7. Do you think that our regulations are adequate to promote GA safety?
8. What do you think is the biggest safety challenge that GA has?
9. If you could change one thing to make GA safer what would that be?
10. Any comments or questions?

Thank interviewee and inform interviewee that a copy of the research will be available as soon as it is complete and published by the university.





12 June 2020

Dear Mr Roos ,

Reference: CURES/11463/2020

Title: Impact of Pilot Total Time, Time on Type and Flight Time in the 90 and 28 Days prior to Accident in UK General Aviation

Thank you for your application to the Cranfield University Research Ethics System (CURES).

We are pleased to inform you your CURES application, reference CURES/11463/2020 has been reviewed. You may now proceed with the research activities you have sought approval for.

If you have any queries, please contact CURES Support.

We wish you every success with your project.

Regards,

CURES Team