AN INVESTIGATION OF HOW COGNITIVE FLEXIBILITY AND ACTIVE COPING STRATEGIES INFLUENCE PILOTS’ STRESS LEVELS WHEN WORKING IN A HIGH-RISK ENVIRONMENT

A Thesis submitted by

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ABTRACT

The aviation industry is a fast-paced and high-risk environment where a pilot is required to tolerate stressful circumstances to maintain appropriate safety standards for the operation of aircraft. Various safety management concepts have been implemented aiming to maximise pilot performance and minimise risk. Nevertheless, accidents occur, and these have disastrous impacts on the whole industry. Many documented aircraft accidents are related to human error, suggesting that some pilots may lack the ability to recover adequately from an unexpected situation. This lack of a suitable response indicates that the current most effective pilot training for operating an aircraft competently may be inadequate. Therefore, there may be additional training elements to be considered. One of these elements is the concept of 'resilience', which has gathered momentum recently with respect to pilot competency in a stressful environment. The aim of this thesis is to identify resilience factors that help to develop or improve pilots' resilience capability when working in the high-stress environment of flying an aeroplane.

This research infers that cognitive flexibility and active coping strategies are important factors in strengthening and maintaining pilots' resilience. To determine whether cognitive flexibility and active coping strategies are capabilities of a resilient pilot, an assessment was executed in two separate studies. The collective findings from the two studies signify that cognitive flexibility and active coping strategies contribute to a resilient pilot. The group of professional airline pilots appeared to have higher cognitive flexibility than the group of 'Experienced in Flying Students' (EFS), and the EFSs in turn had higher cognitive flexibility than the group of 'Non-experience in Flying Students' (NFS). This trend also appeared in the engagement of active coping strategies. These capabilities were found to be strengthened through initial flight training and sustained through the ongoing training process. The findings from this research fully support that cognitive flexibility and active coping strategies are attributes of resilient pilots, and these capabilities should be developed and strengthened from the ab initio to the professional level, so that flight safety can be better assured.

CERTIFICATE OF THESIS

I Maneerat Tianchai declare that the PhD thesis entitled an investigation of how cognitive flexibility and active-coping strategies influence pilots' stress levels when working in high-risk environment is not more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references, and footnotes. The thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

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Student and supervisors' signatures of endorsement are held at the University.

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Working on a PhD during a COVID pandemic was extremely testing my resilience, especially, when the target group of my research was the airline pilots who lost their jobs after the covid struck. Two years in the middle of my thesis that I almost gave up for this unfortunate event and no word could explain my feeling during this difficult time. However, in the middle of this disadvantageous situation I still have my team, my supervisors, or I call them my supporters, Hon. Professor Paul Bates, Associate Professor Tarryn Kille, and Dr. Paul Lee who keep dragging me mentally and physically all the way through this adverse event. Every time I fall, I bounce back and even thrive through all difficult times because of their supports. My team gets a biggest caring heart that I tell myself I will never give up and disappoint them on achieving my PhD.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
CASA	Civil Aviation Safety Authority
CFI	Cognitive Flexibility Inventory
CFS	Cognitive Flexibility Scales
CISS	Coping Inventory for Stressful Situations
CPL	Commercial Pilot Licence
EFS	Experienced in Flying Students
ER	Emotion Regulation
FCM	Flight Crew Member
HRE	Human Research Ethics
HSD	Honestly Significant Difference
ICAO	International Civil Aviation Organisation
JSS	Job Stress Survey
MHS	Multi-Health Systems, Inc.
NFS	Non-experience in Flying Students
OR	Operation Room
PAR	Psychological Assessment Resources, Inc.
PPL	Private Pilot Licence
PSS	Perceived Stress Scale
RPL	Recreational Pilot Licence
SPSS	Statistical Package for the Social Sciences
US	United States
USQ	University of Southern Queensland
WCQ	Ways of Coping Questionnaire

CHAPTER 1: INTRODUCTION

There have been many disastrous airline accidents, including Colgan Flight 3407 (National Transportation Safety Board [NTSB], 2010a), Swissair Flight 111 (Transportation Safety Board of Canada [TSB], 1998) and USAir Flight 1016 (NTSB, 1995), which resulted from unexpected situations during in-flight operations. As a result of the accidents of this nature, many aviation safety regulators including the United States (US) Federal Aviation Administration, European Union Aviation Safety Agency, and Civil Aviation Safety Authority (CASA) have begun suggesting improvements to pilot training to mitigate the risk of unexpected events during an emergency. It is difficult (if not impossible), to learn from those individuals that lose their lives in fatal events. However, a report on an incident involving US Airways Flight 1549 (NTSB, 2010) gives some indication of what can be learnt from pilots who are so resilient during an unexpected event that they manage to bring an aircraft back to the ground safely without loss of life:

> The US Airways flight 1549 departed from LaGuardia Airport (LGA,) New York to Charlotte Douglas International Airport, North Carolina on the 15th of January 2009 (NTSB, 2010). After about 2 minutes from departure time, large birds struck both engines followed by very loud bangs and flames from the engines heard and seen by crew and passengers. This unexpected event resulted in an almost total loss of thrust in both engines. The flight crew tried to go through the procedure to restart the engines as well as making a mayday call to New York Terminal Radar Approach Control seeking options to land their aircraft. Captain Sullenberger was looking for landing options back to LaGuardia Airport Runway 31 as well as nearby Teterboro Airport Runway 1 from Air Traffic Controls on both airports. However, he then realised his aircraft would not be able to reach either runway, thus, he decided to ditch on the Hudson River 8.5 miles from the departure airport. At less than 900 feet (270 m) above the George Washington Bridge, captain commanded over the cabin public address system to 'brace for impact'. 90 seconds later, the unpowered aircraft successfully ditched on the Hudson River with a total of 150 passengers, including a lap-held child and five crew members. The entire

group was safely rescued and only four of them were seriously injured from this accident.

This example highlights that not every unexpected event will end up with a loss of life. It appears that in the face of this stressful, high pressured, risky situation, Captain Sullenberger's capability to quickly identify an unexpected issue and generate multiple solutions to the problem he encountered, as well as persisting to resolve a difficult situation, were key factors in the survival of everybody on his aircraft. In a report by the NTSB (2010) on US Airways Flight 1549, accident investigators stated that one of the main factors reducing the severity of the incident was, 'the decision-making of the flight crew members and their crew resource management during the accident sequence' (p. xv). This accident raises the question: 'Why are some pilots so resilient and what factors help them to be highly resilient in the face of unexpected events when mismanagement of the situation and wrong decision making would cost them their lives?'.

1.1 Statement of Problem

The airline pilot role is considered one of the most stressful jobs in the world since they must ensure aircraft safety with a high degree of responsibility and high workload (Career Cast, 2013; Cranwell-Ward & Abbey, 2005). Pilots' sources of stress can derive from physiological, psychological, and environmental stressors that might arise from inside or outside the aircraft. Stress is a significant factor contributing to impairment in the ability of a pilot to safely control an aircraft (Jeeva & Chandramohan, 2008; Jensen, 2017; Young, 2008). In particular, with increasing stress and pressure from working in a fast-changing, high-risk environment with high workloads, pilots are even more mentally vulnerable in maintaining safety of an aircraft. Several authors (Ebermann & Scheiderer, 2012; Strokes & Kite, 2017; Svenson, 1993) state that humans have a limited ability to tolerate both internal and external stressors; for instance, flying when unwell, working long hours, time pressure, financial problems, marital problems, poor visibility, noise and many more. Many research studies (Durso & Alexander, 2010; Jensen, 1997; Tsang & Vidulich, 2006; Wickens, 2002) provide evidence that stress can affect decision making, reduce situational awareness, lead to fatigue, and impair concentration on important tasks, especially during increased workload.

The emergence of aircraft accidents and incidents resulting from unexpected events led the International Civil Aviation Organisation (ICAO) to improve rules and regulations (informed by research studies) to ensure pilots are trained to develop their skills to achieve a set of competencies required to operate aircraft safely, efficiently, and effectively (ICAO, 2010). This set of competencies includes both technical and non-technical skills to ensure that pilots are capable of controlling the aircraft while maintaining sufficient skills and knowledge, despite encounters with stressors (ICAO, 2013). However, the current robust training procedures, which include many proficiency checks, do not appear to prevent incidents and accidents from occurring. This brings us back to Captain Sullenberger's aircraft incident and his capability to save the aircraft and prevent loss of life to crew and passengers. What other skills or knowledge might still be deficient in pilots in regard to their ability to maintain aircraft safety in an emergency situation?

1.2 The Development of Resilience Research

The concept that theorises to improve pilots' ability, especially, the enhancement of appropriate responses when encountering an unexpected event is 'resilience'. The science of resilience in human development was first studied in the 1960s and 1970s with a focus on children and adolescents, before expanding to other fields of research such as medicine, psychology, and education (Fleming & Ledogar, 2008; Masten, 2007). Researchers aimed to identify whether resilience is an individual trait, a process, or an outcome. Therefore, 'resilience processes' research at the individual level has evolved over the past 50 years through four waves of studies (Masten, 2007; Wright & Masten, 2005). Wright and Masten (2005) explain in detail how in the first wave of resilience research, researchers were aiming to identify an individual's resilience by studying risk and protective factors to distinguish between resilient and non-resilient individuals. In the second wave, the emphasis shifted to embed resilience in developmental and ecological systems, with a focus on processes to become resilient (Wright & Masten, 2005). Wright and Masten (2005) explain that in the third wave, researchers focused on experiments to test resilience ideas directly through prevention and intervention to foster resilience ability. As part of the fourth wave of resilience research, according to Wright and Masten (2005), Wright et al. (2013) suggest that the future of resilience research should be 'a systematic study of the best ways to translate research on resilience processes into effective policies and programs that promote the competence and well-being of the next generation' (p. 33).

While resilience research in human development has advanced in the past 50 years with countless research papers in related fields of study, very limited is known in the area of aviation psychology and medicine, with limited published research relating to airline pilots. When the current study began in early 2017, search keywords 'resilient pilot' and 'aviation and resilience' revealed no peer-reviewed research papers supporting or providing knowledge on what psychological factors might contribute to resilience in pilots. Therefore, to gain a better understanding of resilience, a literature review on resilience research was performed to identify ideas and theories in psychology research given the abundance of supporting evidence in this field of study through the four waves of such research. Resilience research is expected to provide information to improve pilots' non-technical skills with a focus on cognitive and self-management skills, particularly management of stress.

1.3 Aims and Objectives of the Thesis

The key aim of this research was to examine the resilience factors that support to strengthen resilience ability in airline pilots, and it is expected that this ability can enhance safety when working in a high risk environment. The thesis develops research questions and techniques based on previous studies such as psychology and biopsychology in health professions and military service disciplines and adapts them to the aviation environment. Despite the numerous resilience factors that have been discovered in other areas of research, it is challenging to identify which of these can help predict pilots' resilience given that they work in a naturally high-stress environment and may encounter unexpected situations. There are additional challenges including that (1) most resilience research adopts a longitudinal study to observe whether there is a successful outcome after an individual experiences an adverse event; and (2) a very small number of pilots have experienced an in-flight emergency, and these people can be difficult to find. For these reasons, it was impossible during the timeframe of this project to cover all aspects of resilience; thus, this thesis focuses on a subset of areas that most strongly impact aviation.

As previously introduced, this research aims to discover the characteristics of the resilient pilot and processes that help an individual to become resilient and to tolerate the high-stress environment of flying while maintaining aircraft safety. Many psychological factors can promote resilience in humans, as identified by researchers across several disciplines (Reich et al., 2010; Resnick et al., 2010; Southwick et al., 2011). However, when it comes to new contexts involving different high-risk conditions or situations, researchers should examine the resilience factors that are most likely to be influential under the given circumstances of their study (Reich et al., 2010; Southwick et al., 2011). From the literature review on numerous resilience factors, at least five factors—conscientiousness, positive emotion, cognitive flexibility, hardiness, and active coping strategies—are assumed to promote resilience capability in pilots. However, it is not feasible to study all these factors in one thesis. For this reason, this research aims to examine two factors—cognitive flexibility and active coping strategies—hypothesised to enhance pilots' non-technical skills (i.e., cognitive skills and self-management skills—the management of stress). It is expected that the understanding of how these two factors affect pilots' resilience can be developed or improved over time, and thus that appropriate training methods can be introduced.

The researcher has identified issues that limit the study of pilot resilience; it is difficult to identify the truly resilient pilot as this requires pilots to have survived an unexpected situation similar to that experienced by Captain Sullenberger. According to Masten (2007) and Windle (2011), individuals can demonstrate resilience only when (1) they encounter a risky situation; (2) they show the ability to withstand and remove the risk; and (3) they can avoid a negative outcome. In accordance with this consideration, resilient pilots must be those who have been exposed to significant risk and subsequently demonstrate evidence of positive adaptation despite serious threats, which is a rare occurrence in aviation. However, efforts were made in this research to investigate resilience factors that help predict pilots' behaviour when responding to different types of stressors during their routine work.

In the current investigation, the goal of this research is to make a contribution to resilience knowledge in the field of aviation. It is expected that cognitive flexibility and active coping strategies are two resilience factors that can minimise stress levels and enhance pilots' resilience. Cognitive flexibility encompasses the ability to shift a course of thought or action according to the changing demands of the environmental information or situation (Cañas et al., 2003; Dennis & Vander Wal, 2009; Lezak et al., 2004). Genet and Siemer (2011) suggest that this flexibility in thinking and adapting to change is a construct of the resilience trait. Active coping strategies are coping efforts directed at solving, managing, or improving a problem causing distress (Folkman, 1984; Folkman & Lazarus, 1980; Kahn et al., 1964). Some researchers (Anthony, 1987; Kumpfer, 2002) claim that coping ability is one of the main components of resilience. In relation to these two resilience factors, this research study was designed to investigate how 'cognitive flexibility' and 'active coping strategies' influence pilot stress levels when working in a high-risk environment. Additionally, this study utilised demographic variables including level of flying experience, workload, age, gender, and rank to help identify which of these factors might support the development and/or improvement of resilience in pilots. These variables may also assist in distinguishing which factors may influence stress and resilience levels.

In summary, the accident case study of US Airways Flight 1549 indicated that the pilots appeared to demonstrate a resilience ability to manage an unexpected event with the consequence of no loss of life. With the positive outcome of this accident, this research aims to investigate resilience factors that help to enhance pilots' flying performance when working in a high-risk environment and maintain flight safety. This research adopts the studies in other environments and industries such as health professions and military service and applies their research findings to the aviation discipline. It is predicted that "cognitive flexibility" and "active coping strategies" could be the important factors to enhance a pilot's resilience to work effectively in a high-risk environment. The study will also investigate different demographic variables such as level of flying experience, age, gender, workload, and rank to examine whether any of these factors could also affect the pilots' resilience ability.

CHAPTER 2: LITERATURE REVIEW

ICAO (2010) requires pilots to operate an aircraft safely, effectively, and efficiently to comply with Annex 6–Aeroplanes, paragraph 9.3, Flight crew member training programmes; and paragraph 9.4.4. Pilot proficiency checks. Under these regulations, pilots are required to meet a set of competencies that include application of procedures, communication, both automated and manual aircraft flight path management, leadership and teamwork, problem solving and decision making, situation awareness, and workload management, which encompass the technical and non-technical knowledge, skills and attitudes required to operate aircraft safely (ICAO, 2013). This set of competencies emphasises the importance of non-technical skills that are highly significance for the operation of an aeroplane as well as maintaining the safety of flight. O'Hare et al. (1994), and Wiegmann and Shappell (1999) estimate that 60–80% of aircraft accidents and incidents are caused by human factors. For this reason, non-technical skills training is vital as it can minimise the chance of an incident leading to a catastrophic event.

2.1 Pilots' Non-technical Skills Ensure Safety

Pilots' non-technical skills are fundamental to flight safety as pilots have to work under high-workload conditions to maintain safe operation of an aircraft. CASA (2011) defines 'non-technical skills as the mental, social, and personal-management abilities that complement the technical skills of workers and contribute to safe and effective performance in complex work systems' (p. 8). Non-technical competencies are the cognitive skills (situation awareness and decision making), social skills (communication, teamwork, and leadership) and self-management skills (management of stress and fatigue) required for the safe operation of the aircraft. CASA (2011) highlights that those deficiencies in these non-technical skills could increase the chance of human error, which may develop into an adverse event in the workplace. This can be seen from many case studies across a variety of high-reliability industries, which include the Tenerife Airport disaster (Netherlands Aviation Safety Board, 1979), Three Mile Island accident (Nuclear Safety Analysis Centre, 1980), BP Texas City Refinery explosion and fire (US Chemical Safety and Hazard Investigation Board, 2007) and Kegworth plane crash (Royal Aerospace Establishment [RAE], 1990). CASA (2011) also emphasises that non-technical skills are not just important for managing critical situations or emergencies but are also useful for optimising safety and performance during routine work conditions.

Flin and O'Connor (2017) state that 'human error cannot be eliminated, but efforts can be made to minimise, catch, and mitigate errors by ensuring that people have appropriate non-technical skills to cope with the risks and demands of their work' (p. 1). Many practices have been implemented to minimise the chance of human error by aiming to strengthen pilots' performance. However, such practices are still not capable of entirely eliminating human error if the performance of a pilot is impaired in a fast-changing, stressful, and sometimes threatening environment.

This research recognises the importance of these non-technical skills as identified in other research studies (Driskell & Salas, 2013; Driskell, et al., 2006; Staal, 2004). particularly in relation to the management of stress. It has been found that stress can empower or deplete a human's physical, emotional and mental capabilities. Findings from various studies (Allen et al., 2014; Schoofs et al., 2013; Schwabe et al., 2013; Shields et al., 2016; Starcke & Brand, 2012) also indicate that stress has important effects on many cognitive processes, such as working memory, decision making and response inhibition. After reviewing the literature on the effect of stress and how it could affect pilots' non-technical skills, the researcher acknowledges the importance of cognitive and self-management skills (especially the management of stress).

Stress is considered one of the factors that can impair pilot cognitive abilities and is particularly relevant when pilots have to perform their work under difficult conditions such as flying through bad weather or encountering an emergency during flight. This begs the question of what other skills or factors could be learnt to further improve a pilot's capability to manage stress well when encountering adverse events in their work environment where safety is critical. The resilience concept is thus adopted in this research for pilots as it can be adapted to examine stress and adversity during emergency flight operations (Wu et al., 2013). Resilience is widely considered to promote the ability to withstand adverse events and hardships during stressful times (Lazarus & Folkman, 1984; Masten et al., 1990; Reich et al., 2010; Southwick et al., 2011). To adapt this concept to the aviation discipline, psychological factors that might predict pilot resilience need to be identified so that pilots can perform better when working in their regular high-risk environment, as well as when they encounter serious or unexpected events during in-flight emergencies.

2.2 From Stress to Resilience

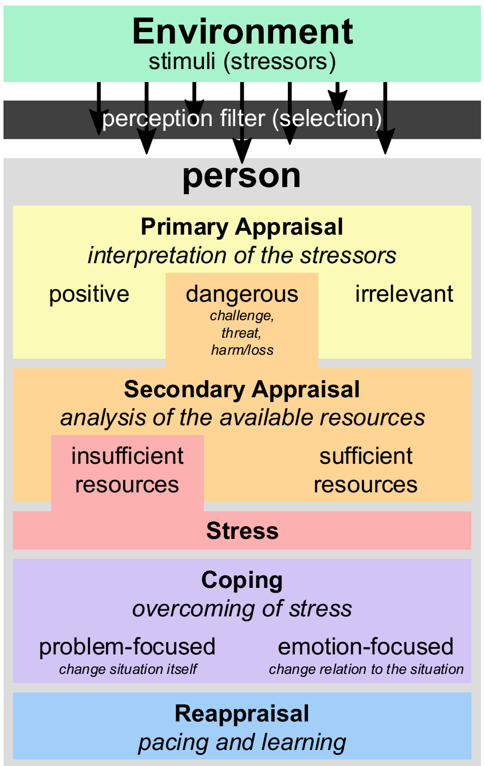
Stress plays a vital role in pilot performance and causes limitations that can impair task performance during flight operations (Bourne & Yaroush, 2003; Driskell et al., 1992; Driskell & Salas, 1996; Staal, 2004; Stokes & Kite, 2017). Stress can be induced by physical, physiological, psychological, or environmental factors, and resulting impairment negatively affects cognitive processes, which reduces the quality of situational awareness and decision making (Cooper & Sloan, 1987; Reid, 1948; Stokes & Kite, 2017; Young, 2008). Flin and O'Connor (2017) deduce that high stress can affect team leaders' and members' effectiveness, leading to a decrease in communication and teamwork, and an increase in errors, affecting overall team performance. Various types of stressors have an effect on many aspects of a pilot's non-technical skill abilities; for instance, situational awareness and awareness of performance shaping factors (fatigue and perceived workload). Reduced performance can make pilots vulnerable in a risky or threatening environment such as engine failure, system malfunction or adverse weather conditions. In addition, if acute stress—that is, stress that develops quickly and lasts for a short period of time—is not managed adequately, it can result in chronic stress, or a prolonged and constant feeling of stress, which will dramatically reduce an individual's health and wellbeing (Hammen et al., 2009).

In any discussion of stress, the 'appraisal theory' of Richard Lazarus is one of the most influential theoretical perspectives concerning psychological stress and coping (Smith & Kirby, 2011). This transactional model remains the cornerstone of psychological stress and coping research across multiple fields (Biggs et al., 2017; Smith & Kirby, 2011). Lazarus and Folkman (1984) define stress as 'a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being' (p.

19). The most critical aspect of this definition is how an individual's 'cognitive appraisal' responds to the circumstances influencing their wellbeing or safety. Lazarus (1966), Lazarus and Folkman (1984) and Lazarus and Launier (1978) divide this appraisal process into two steps (as illustrated in Figure 2.1). The primary appraisal involves evaluation of what is at stake in the encounter—whether it is irrelevant, beneficial, or dangerous. The secondary appraisal is an evaluation of options and resources for coping with a stressful encounter and whether anything can be done about it. If the primary appraisal interprets the stressor as dangerous, then the stress-elicited conditions are classified as a harm/loss, threat, or challenge (Lazarus & Folkman, 1984). The secondary appraisal then analyses whether there are sufficient resources to deal with the stress.

Figure 2.1

Richard Lazarus's Transactional Model of Stress and Coping



Note. Adapted from 'Appraisal Theory', by P. Guttmann, 2016, https://en.wikipedia.org/wiki/Appraisal_theory#/media/File:Transactional_Model_of_Stress_and_Coping_-_Richard_Lazarus.svg. Copyright 2016 by Philipp Guttmann. In the public domain.

Smith and Kirby (2011) further explain Lazarus's appraisal theory process as suggesting that an appraisal of harm/loss reflects a situation in which the person has already experienced a setback in their goals and pursuits. When an individual appraises the situation as a threat, they focus on the potential of the situation to cause future harm or loss. However, when an individual appraises the situation as a challenge, they focus on the potential for personal gain or growth. Smith and Kirby (2011) add that these appraisals are associated with an effect that can be negative in response to a harm/threat, or a mix between positive and negative in response to a challenge, which will prompt coping. This explanation elucidates the process of human stress appraisal. The understanding of stress appraisal will help to indicate where resilience processes may begin to operate, and which resilience factors may minimise or override the negative effect of stressors during a threatening situation.

Reich et al. (2010) claim that resilience has emerged as one of the most heuristic and integrative concepts in twenty-first century thinking in the social sciences. Reich et al. (2010) consider the 'resilience concept' as a response to stressful events, whether resilience focuses on recovery, the ability to rebound from stress or the capacity to regain equilibrium quickly and return to the initial state. Friborg et al. (2005) point out that two important reasons for operationalising and measuring resilience: first, it may provide evidence for clinical psychology about which factors are most important for regaining and maintaining mental health for different individuals; second, being able to predict the ability to tolerate stress and negative effects may help in the selection of personnel likely to manage more difficult job demands.

Numerous researchers have been investigating resilience by studying risk factors, characteristics of resilience, the relationship between resilience and other factors, and ways to promote a positive lifestyle and minimise risk to gain a better understanding of resilience (Ballenger-Browning & Johnson, 2010; Leipold & Greve, 2009; Luthar et al., 2006; Montpetit et al., 2010; Sameroff & Rosenblum, 2006). Unfortunately, no research has identified clear-cut evidence regarding what creates resilient individuals in whatever situation they encounter. The various resilience factors need to be re-identified in the face of new challenges or new environments, in different conditions under study. For this reason, in the specific stressful environment of flying an aircraft, resilience factors need to be examined to define elements of pilot resilience that enhance flight safety.

2.3 Defining Resilience

'Resilience' is the useful ability to recover quickly from disruptions in functioning that result from stressful situations and redirect potential threats into positive outcomes, or even thrive from adverse events (Carver, 1998). McCubbin (2001) states that 'resilience has become an umbrella term to cover many different aspects of overcoming adversity and adapting to one's environment' (p. 3). Resilience is conceived as an end-product of buffering processes that do not eliminate risks and stress but allow the individual to deal with them effectively (Rutter, 1987). Resilient people tend to demonstrate a greater capacity to quickly regain equilibrium physiologically and psychologically. This also occurs in social relations following stressful events as well as in the sustaining of health and psychological wellbeing in a dynamic and challenging environment (Zautra et al., 2010). It follows that 'resilience' involves an inference based on findings concerning individual differences in response to stress or adversity.

The term resilience is applied across multidisciplinary studies ranging from the individual perspective to that involving the environment, communities, organisations or even nations. However, the current review refines its scope to individual-level resilience. At an individual level, the study of resilience is expanding rapidly through the work of researchers from diverse disciplines including psychology (Pietrzak et al., 2009), sociology (Pietrzak et al., 2010), psychiatry (Campbell-Sills et al., 2006; Haglund et al., 2007) and, more recently, biological disciplines including epigenetics (Feder et al., 2009; Southwick et el., 2005), neuroscience (Haglund et al., 2007) and endocrinology (Charmandari et al., 2005; Sapolsky, 2002). Masten (2001) states that 'the great surprise of resilience research is the ordinariness of the phenomenon as resilience appears to be a common phenomenon that results in most cases from the operation of basic adaptational systems' (p. 227). In the current research, the personal level of resilience is targeted, and the literature is reviewed with a focus on research at the individual level.

Kumpfer (2002) proposes that resilience can only be demonstrated when a person experiences some type of stressor or challenge. Masten (2007) and Windle (2011) indicate that three key features emerge from analyses demonstrating the experience of resilience: (1) the encounter with a risky situation; (2) the ability to withstand and solve the risk; and (3) the avoidance of negative outcomes. Ong et al. (2009) propose that the stimulus in any resilience situation can be exposure to significant risk followed by evidence of positive adaptation despite serious threats. Indeed, the maintenance of competence in the presence of distress is the strongest form of resilience (Windle, 2011).

Several studies theorise that the indicators of positive adaptation can differ across contexts, populations, and risk factors. Rutter (1987), Masten et al. (1990) and Norman (2012) conceptualise the phenomenon of positive adaptation through resilience from four interrelated but distinct perspectives; (a) as good developmental outcomes despite high risk; (b) as sustained competence under stress; (c) as recovery from crisis; and (d) as the interaction between protective and risk factors. Research on the protective notion of resilience concentrates on what people do to deal with stress or adverse events by focusing on coping mechanisms, the operation of personal agency and the mindset. Rutter (2006) suggests that this requires a move from a focus on external risks to a focus on how these external risks are dealt with by the individual. Moreover, this dynamic adaptive system can be reorganised to create new resilience in a new challenging environment.

In summary, disturbance is an important part of the process of resilience where individuals develop a range of coping strategies to deal with a combination of threatening situations or unpleasant emotions and are able to bounce back from adverse events. Additionally, Southwick et al. (2011) suggest that the type and degree of stress or threat has a significant effect on resilience processes and outcomes. They specify that even the best-trained elite athletes, professionals (military service, health professions) or warriors have limits that are beyond their control. When people are at the end of their stress limit, they can no longer function adequately—at least for some period of time. Egeland et al. (1993) suggest that the notion of resilience is the potentiality that develops over time in the context of person–environment interactions. Egeland and colleagues postulate that people must be determined to be resilient when facing stressors and hardship so that their resilience ability is strengthened when they confront hardship in later stages of life.

2.3.1 Resilience's Definitions in Various Aspects

The word 'resilience' is derived from the Latin verb *resilire*, meaning to spring back or rebound (Dictionary.com, 2017). The Cambridge Dictionary (2017) defines resilience as 'having the ability to quickly return to a previous good condition' and the American Psychological Association (2017) defines it as 'the process of adapting well in the face of adversity, trauma, tragedy, threats, or significant sources of stress'. In general, resilience is broadly defined as the ability to bounce back to overcome adversity (McCubbin, 2001).

In human behavioural sciences research, there are broad differences in the way the resilience concept is interpreted. The conceptualisation of resilience can lead to the research boundary and research setting; thus, resilience can be properly analysed whether it is existed or absent. Southwick et al. (2014) point out that 'in defining resilience, it is important to specify whether resilience is being viewed as a trait, a process, or an outcome' (p. 2). They also suggest that the binary approach can be utilised when considering whether resilience is present or absent. Pietrzak and Southwick (2011) explain that resilience more likely exists on a continuum and presents in different degrees across multiple domains of life. People who appear to adapt well in one environment may fail to adapt under other conditions. This is why, in a research setting, participants may appear to be resilient in one research environment but may not demonstrate resilience in alternative circumstances. Thus, research should examine or re-examine whether certain resilience factors are truly present in the participants and environments under study.

To understand the differences between the definitions of resilience when it is viewed as a trait, a process, or an outcome and which resilience concept is best to apply in this research, the following definitions are reviewed. When resilience is defined as a personality trait, it refers to a personality characteristic or inherent ability that moderates the negative effects of stress and promotes adaptation and bounce back from stressful experiences (Block & Kremen, 1996; Tugade & Fredrickson, 2004; Wagnild

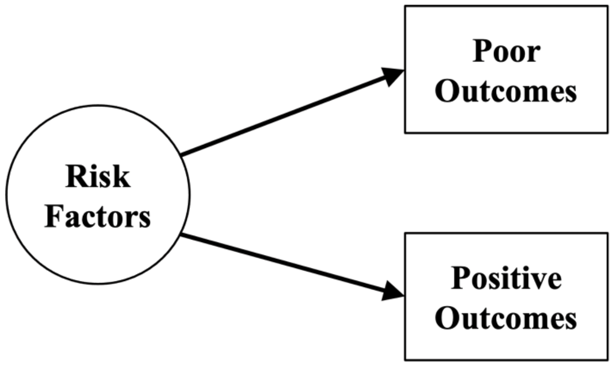
& Young, 1993). When resilience is defined as a dynamic process, it refers to the process where the individual interacts with the ever-changing environment with sufficient capacity to negotiate, adapt or manage in the face of adversity (Egeland et al., 1993; Luthar et al., 2000; Masten & Wright, 2010). When resilience is conceptualised as an outcome, Masten (2001) defines it as ‘a class of phenomena characterised by good outcomes despite serious threats to adaptation or development’ (p. 228).

McCubbin (2001) points out that these different perspectives of resilience serve as a built theory and inform measurement strategies for the construct to ensure the veracity of a research inquiry. For example, if resilience is conceptualised as an outcome, McCubbin (2001) explains that research usually involves two groups (as shown in Figure 2.2): one is classified as having poor outcomes (e.g., crime, drugs use and alcohol abuse) while a second group is classified as having positive outcomes (e.g., positive academic achievement or healthy relationship). If both groups have been exposed to the same type of risk, the outcomes for the two groups can be a measure of their resilience capability. If resilience is viewed as a personality trait, then the researcher should emphasise measurement of the personality traits (e.g., openness, extraversion, neuroticism, agreeableness, and conscientiousness) of participants in their research (Ercan, 2017; Fayombo, 2010) to identify which traits are linked to resilience capability.

In this research, the researcher adopts the conceptualisation of resilience as a process because it is believed that pilots should be able to interact with an ever-changing environment with sufficient capacity to negotiate, adapt or manage in the face of emergency situations and this ability should be able to develop, improve or be sustained in people who work in the flying environment. Therefore, resilience as a process and associated research directions are discussed in the next section.

Figure 2.2

Resilience as an Outcome



Note. Adapted from 'Challenges to the Definition of Resilience', by L. McCubbin, 2001, *Paper presented at the Annual Meeting of the American Psychological Association*, p. 7. Copyright 2001 by Education Resources Information Centre.

2.3.2 Resilience Conceptualised as a Process

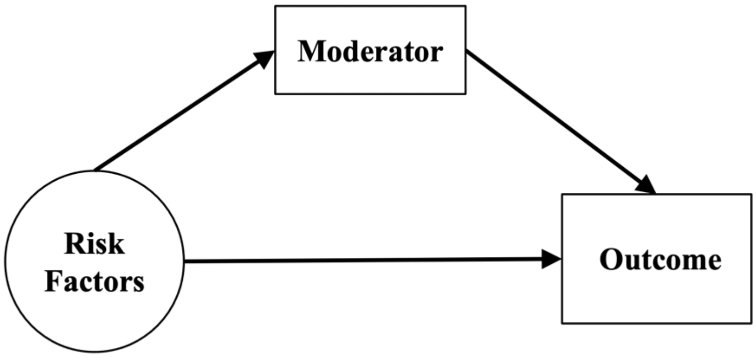
This research views resilience as a process because it is considered to operate as a factor that can influence outcomes and be developed over time. McCubbin (2001) states that 'resilience is considered to be a construct that moderates the relationship between risk factors and outcome variables' (p. 7). Egeland et al. (1993) believe that resilience is a capacity that develops over time in the context of person–environment interactions, while Burt et al. (2016) refers to resilience as processes and patterns of positive adaptation in development. Fletcher and Sarkar (2013) view resilience as a dynamic process because protective/supportive factors have effects that vary from situation to situation, throughout one situation, or across a human's lifespan. Considering these perspectives of resilience, it can be expected that resilience is a capability that can be developed or improved by identifying protective/supportive factors that assist in strengthening the resilience performance as well as enhancing pilot's non-technical skills.

McCubbin (2001) suggests that when conceptualising resilience as a process in a research setting, resilience serves as a moderator between risk factors and outcome variables (as shown in Figure 2.3). This occurs when resilience factors become operative to moderate the effect of risk before it has negative or positive consequences.

McCubbin (2001) points out that multiple moderating variables are already examined in the literature and the research should be designed to identify the factors that most strongly affect the participants in the study. With consideration and reference to the literature reviewed thus far, this resilience study adheres to the conceptualisation of resilience as a process. The remaining review of the literature questions which resilience factors might moderate the effect of stress on pilots, who work in a high-risk environment.

Figure 2.3

Resilience as a Process



Note. Adapted from 'Challenges to the Definition of Resilience', by L. McCubbin, 2001, *Paper presented at the Annual Meeting of the American Psychological Association*, p. 8. Copyright 2001 by Education Resources Information Centre.

In summary, there is a broad range of definitions of resilience, and its conceptualisation can help a researcher establish the theoretical boundary and veracity of their research inquiry. When resilience is viewed as a capability that changes over time, it is defined as a process that evolves with the ever-changing environment. Studying the resilience process involves the identification of moderators (supportive/protective factors) that help to reduce the effect of risk before it has positive or negative outcomes. Given that resilience in an airline pilot should be a capability that is trainable over time and that can enhance the chance of an adequate response in an emergency situation, this research aims to identify resilience factors that can be used as moderators to reduce the effect of stress and enhance pilots' non-technical skills when working in the high-risk environment of flying an aeroplane.

2.4 Resilience—Nature vs Nurture

Anecdotal evidence suggests that resilient individuals are born to be so. This echoes the historical belief that some pilots are born to become great airmen. Despite a scientific literature on resilience and human development (Masten, 2001, 2007; Reich et al., 2010; Rutter, 2006; Sameroff & Rosenblum, 2006; Southwick et al., 2011), research has validated the fact that resilience capability can be developed in the same way as physiology evolves over a person's lifespan. Benard (1995, p. 2) characterises the nature of resilience as follows: 'we are all born with innate resiliency, with the capacity to develop the traits'. Siebert (2009) states that the most empowering finding in resiliency–psychology research is that a person has an inborn predisposition to become resilient and change proficient. Lown et al. (2015) emphasises that resilience is not a static trait that some have, and others lack. Although nature and nurture both play a part, the development of resilience depends greatly on circumstances, environment, knowledge, skills and, more importantly, attitude.

2.4.1 Resilience Viewed as Nature

The association between genes and the brain, genes and behaviour, and genes and social relationships is a complex aspect of human nature. Evidence on the neurobiological basis of resilience has begun to emerge from research on the adaptive stress response at multiple phenotypic levels, but the range of complex mechanisms that lead to resilient phenotypes is far from fully determined (Feder et al., 2009). Feder et al. (2009) explain that resilience is mediated by an adaptive change in several neural circuits involving numerous neurotransmitter and molecular pathways. For example, Kloet et al. (2005) find that resilience is associated with the capacity to constrain stress-induced increases in corticotrophin-releasing hormone and cortisol, through an elaborate negative feedback system involving optimal function and balance of glucocorticoid and mineralocorticoid receptors. Another study shows that neuropeptide Y and the hormone 5-dehydroepiandrosterone respectively limit the stress response by reducing sympathetic nervous system activation and protecting the brain from the potentially harmful effects of chronically elevated cortisol level (Charney, 2004). These experiments indicate that resilience is somehow associated with brain activation as part of the stress response and how efficient of the brain function to terminate stress. However, the complexity of resilience viewed as being due to genetic is far from fully determined and many researchers (Luthar et al., 2006; Rutter, 2007; Southwick et al., 2010) believe that resilience is a capability that can be nurtured beyond the genes and brain perspective.

2.4.2 Resilience Viewed as Nurture

Lemery-Chalfant (2010) suggests that resilience research has advanced beyond the nature versus nurture debate, or the relative importance of genes and the environment for developing a person, with the focus moving towards the understanding the interplay between the two. Lemery-Chalfant (2010, p. 57) concludes that resilience requires intrinsic and extrinsic processes of successful adaptation to adversity, and that genetic variation contributes to individual differences in these capacities, with adaptation and positive outcomes not limited to initial states. Moreover, Lemery-Chalfant (2010) considers that resilience can be influenced by an individual's development over time, which means that what was effective before may not work in a new environment. Rutter (2007) states that people may be resilient in relation to some kinds of environmental hazard but not others. Equally, they may be resilient with respect to some outcomes, but not all.

Collectively, researchers agree that resilience can be nurtured beyond the genetic influence by fostering intrapersonal strengths and competencies and developing interpersonal skills (Masten et al., 1990; Skodol, 2010). These two aspects work in a dynamic process to enhance resilience capability and are seen as protective factors in resilience development. Luthar et al. (2006) and Windle (2011) describe protective factors in the resilience context as generic terms for interpreting the individual's capability to respond positively to risks and alter or minimise the effects of adversity. Protective factors may also be perceived as assets, resources, or strengths (Aldwin et al., 1996; Sacker & Schoon, 2007), where the assets or strengths are distinguished as individual-level protective factors, but resources are viewed as external to the individual. Feder et al. (2010) assert that adaptive responses to stress can be promoted by strengthening potential protective factors.

Resilience capability is not driven by a single protective factor; rather, researchers have discovered an abundance of factors that might make people resilient. Herrman et al. (2011) suggest that some factors that increase resilience may become active at a particular stage of life, but others may operate across the lifespan. When considering enhancing resilience factors, targeted factors must be examined to identify whether they are viable in the given circumstance. Several studies have identified a range of psychosocial factors that promote successful adaptation to stress and adversity in a specific situation. Southwick et al. (2011) point out that resilience is associated with a number of psychosocial factors that appear to have a protective role in highly challenging and stressful situations.

Numerous studies provide evidence of personality traits that appear to contribute to resilience. These include openness, extraversion, neuroticism, agreeableness, and conscientiousness (Ercan, 2017; Fayombo, 2010), internal locus of control (Friborg et al., 2003; Kumpfer, 2002; Richardson, 2002), mastery (Burns et al., 2011; Southwick & Charney, 2012), self-efficacy (Bandura, 1993; Bandura, 2010), self-esteem (Liu et al., 2014) and cognitive appraisal (positive interpretation of events and cohesive integration of adversity into self-narrative) (Rutter, 1987; Troy & Mauss, 2011). The conscientiousness personality trait is the best predictor of psychological resilience, as highly conscientious people are in the habit of being always prepared; for example, they get chores done quickly, pay attention to detail and stay calm in stressful situations (Fayombo, 2010). These habits reduce their tension and strengthen their intrinsic ability to cope more effectively with stress.

A group of pioneering resilience researchers indicate that intellectual functioning (Masten, 2001; Masten et al., 1990), cognitive flexibility (Genet & Siemer, 2011; Hildebrandt et al., 2016), social attachment (Charuvastra & Cloitre, 2008; Janicki-Deverts & Cohen, 2011), positive self-concept (Olsson et al., 2003), emotional regulation (Bonanno, 2005; Troy & Mauss, 2011), positive emotions (Fredrickson & Levenson, 1998; Fredrickson et al., 2003), spirituality (Faigin & Pargament, 2011; Foy et al., 2011), active coping (Leipold & Greve, 2009; Steinhardt & Dolbier, 2008), hardiness (Florian et al., 1995; Maddi, 2005), optimism and hope (Luthans et al., 2004; Youssef & Luthans, 2007), resourcefulness (Bakker & Passegué, 2013; Ramaswami, 2009) and adaptability (Folke et al., 2010; Pike et al., 2010) are associated with resilience. For instance, active coping is the psychological or behavioural coping effort applied in attempting to use one's own resources to deal with stressors while controlling ones' internal adjustments during stressful events to remain resilient.

Additionally, demographic factors (age, gender, race, and ethnicity) (Bale & Epperson, 2015; Bonanno et al., 2007), social relationships (Helgeson & Lopez, 2010; Rutter, 1985) and population characteristics (Luck et al., 2003) are often found to relate to resilience, depending on study methods and resilience definition (Herrman et al., 2011). For example, a study on early career teachers by Mansfield et al. (2014) identifies that building supportive relationships with colleagues helps these teachers to become more resilient.

Individuals cannot strengthen their resilience capacity without a healthy and supportive environment in which to enhance their interpersonal skills. Walsh (2002) considers that ideas about resilience are too focused on personal strengths, and consistent findings across many studies show that resilience may be nurtured by supportive relationships. Kent and Davis (2010) and Southwick et al. (2014) believe that the qualities of a person alone are not sufficient to predict resilience; more importantly, providing a healthy environment and social support will foster the individual's natural protective systems to develop and operate effectively. Some studies support the notion that in a stressful situation, secure attachment relationships can reduce negative effects and physical arousal in a stressful situation (Charuvastra & Cloitre, 2008; Mikulince et al., 2003).

In summary, Southwick et al. (2014) contend that resilience is determined by both DNA (deoxyribonucleic acid) and non-DNA factors, including support systems and opportunities to develop resilience. Charney (2004) states that psychobiological, personality and social behavioural factors have been identified that together may serve to protect a person from stress. It is also important to recognise that determinants may differ from one person to the next based on multiple factors such as personality, specific challenges, resources available and environmental context. The determinants of a resilient pilot in the context of aviation include the mindset and eagerness to keep an aircraft operating safely. For this reason, pilots must exhibit a number of resilience characteristics that are suitable for further development to ensure safety in flying.

2.5 Risk Factors and the Supportive–Protective Factor Interplay

Resilience is an interactive concept that can only be studied through thorough measurement of risk and protective factors (Rutter, 2006). These factors vary depending on an individual's character and environmental circumstances. Rutter (1979), Werner (1989) and Masten et al. (1990) consider that the greater the risk factors, the more likely it is that maladaptive behaviours or outcomes will occur. Werner (1989) asserts that the more risk factors that are present, the more protective factors are needed to compensate. Therefore, protective factors can only be defined in connection with risk factors because of their interrelatedness (Rutter, 1979).

In resilience research, 'risk' has become a catch-all term for a multitude of conditions that may lead to negative outcomes (Morrison & Cosden, 1997). Masten and Wright (2010) describe risk as a factor that may hinder normal functioning. A risk factor is something that, for most people, could lead to distress and potentially detrimental outcomes. Some researchers align the notion of risk with adversity; for example, Luthar and Cicchetti (2000, p. 858) state that 'adversity typically encompasses negative life circumstances that are known to be statistically associated with adjustment difficulties'.

In the aviation context, CASA (2012) defines risk as the chance that somebody could be harmed by various hazards, together with an indication of how serious the harm could be. A hazard is defined as anything that could cause harm, damage, or injury, or have a negative consequence (CASA, 2012). In its *Safety Management Manual*, ICAO (2013) refers to humans who work in front-line operations as 'liveware' and place them at the centre of the SHELL Model. SHELL Model is commonly used to illustrate the impact and interaction of the different system components on the human with a strong consideration on human factors as an integrated part of Safety Risk Management (ICAO, 2013). ICAO (2013) asserts that liveware is subject to considerable variation in performance that can be influenced by several internal and external environment factors, and that a decline in performance could jeopardise safety.

ICAO (2013) explains that risk factors that come from the environment include internal workplace environment, external environment, psychological and physiological forces, and the aviation work environment. The internal workplace environment includes physical considerations such as temperature, ambient light, noise, vibration, and air quality. The external environment includes operational aspects such as weather factors, aviation infrastructure and terrain. This interface also involves the relationship between the human internal environment and the external environment. Psychological and physiological forces including illness, fatigue, financial uncertainties, and relationship and career concerns can be induced by the liveware–environment interaction or originate from external sources. The aviation work environment brings disturbances to normal biological rhythms and sleep patterns. These additional environmental aspects are all considered risk factors that can affect a pilot's non-technical skills and decision-making processes and create pressure to develop 'workarounds' or minor deviations from standard operating procedures.

Having evaluated risk factors in the aviation environment that may affect pilots' non-technical and technical skills (as summarised in Table 2.1), pilots' resilience is most likely to become apparent and tested only when these risk factors emerge. Morrison and Cosden (1997) demonstrate that the concepts of risk and resilience imply chronology and causality: risk implies that one factor precedes an outcome; and resilience implies that protective factors act on risk conditions to reduce or correct the damage wrought by risk factors. Masten and Wright (2010) analyse typical models of resilience and conclude that these models generally include risk factors or conditions that threaten positive function, assets or resources that promote good outcomes, as well as protective/supportive factors or processes that are particularly effective under given circumstances. Therefore, protective factors are assumed to be functions that buffer against risk factors or can moderate risk factors and protect against poor outcomes (Masten et al., 1990).

Table 2.1

Summary of Risk and Resilience Factors From the Review of the Literature

Risk factors of liveware			
Physical consideration	**Operation aspect**	**Psychological & Physiological forces**	**Aviation work environment**
• Temperature • Ambient light • Noise • Vibration • Air quality	• Weather factors • Aviation infrastructure • Terrains	• Illness • Fatigue • Financial uncertainty • Relationship concern • Career concern	• Disturbance to normal biological rhythms and sleeping patterns

Resilience factors		
• Conscientiousness • Internal locus of control • Mastery • Self-efficacy • Self-esteem • Hardiness	• Cognitive appraisal • Intellectual functioning • Cognitive flexibility • Social attachment • Positive self-concepts • Emotional regulations • Positive emotions	• Spirituality • Active coping • Optimism and hope • Resourcefulness • Adaptability • Social relationship

In summary, researchers such as Benight, Cieslak, Mancini, Bonanno, Masten, Wright, Troy and Mauss who contributed to the *Handbook of Adult Resilience* (Reich et al., 2010) and the *Resilience and Mental Health: Challenge Across the Lifespan* handbook (Southwick et al., 2011) have identified abundant evidence that individuals can develop resilience capability over time, but that establishing protective factors in the face of new risk factors can be very challenging. Masten and Wright (2010) assert that resilience does not require extraordinary intelligence in most cases; rather, it requires the operation of the human brain in 'good working order' and access to knowledge about what is happening, what to expect and what to do. Moreover, Reich et al. (2010) assert that social competence and use of social supports increase resilience in the face of threatening situations. It may be challenging for the aviation industry to identify what psychological resilience factors are linked to safer operations and enhance human safety behaviour to promote non-technical skills, especially the management of stress.

2.6 Supportive Factors in Pilots' Non-technical Skills

With regard to enhancing flight safety, resilience research aims to promote pilots' self-management processes (management of stress), which are one component of the required non-technical skills. Multiple personality traits such as conscientiousness and hardiness may be attributes of the resilient pilot. However, the evidence presented in the previous section is sufficient to support that resilience can be nurtured over time, which can be enhanced throughout the human lifespan. Therefore, this study aims to investigate resilience factors that can be developed or improved during the process of becoming more resilient.

Cognitive flexibility (Burton et al., 2010; Genet & Siemer, 2011) and active coping strategies (Campbell-Sills et al., 2006; Kumpfer, 2002; Leipold & Greve, 2009) demonstrate specific characteristics hypothesised to be attributes that can be developed to enhance safety by improving pilots' non-technical skills. These two protective factors are selected here because they are envisaged to enhance pilots' intrapersonal capability and reduce the likelihood of negative responses to stressful situations. Together, these factors may contribute to high levels of psychological adaptive functioning; thus, this study focuses on these two traits.

2.6.1 Cognitive Flexibility

One of the main elements of pilots' non-technical skills is cognitive skills; these include situational awareness (attention to the work environment) and decision making (Flin & O'Connor, 2017). Endsley (1995) defines situational awareness as 'the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future' (p. 36). Shrestha et al. (1995) states that:

> situation awareness is a dynamic, multifaced construct that involves the maintenance and anticipation of critical task performance events. Crew members must also have temporal awareness, anticipating future events based on knowledge of both the past and the present. It is crucial that individuals monitor the environment so that the potential problems can be corrected before they escalate. (p. 52)

However, there may be circumstances where situational awareness is inadequately maintained and drifts; suddenly the pilot must prepare for an unexpected situation. It is important to recognise the cognitive function required to encounter this immediate decision making and recover from an emergency situation quickly enough to regain aircraft safety.

The complex and ever-changing environment of the flying operation requires pilots to be cognitively flexible. Cognitive flexibility is defined as 'the readiness with which the person's concept system changes selectively in response to appropriate environmental stimuli; it is assessed by inviting the subject to expand the groups he/she has created on the original sorting task' (Scott, 1962, p. 405). In other words, cognitive flexibility involves the ability to shift a course of thought or action according to the changing demands of the environmental information or situation (Cañas et al., 2003; Dennis & Vander Wal, 2009; Lezak et al., 2004). Genet and Siemer (2011) propose that the construct of the resilience trait involves flexibility in adapting to change, as they consider that resilience is linked to flexibility in thinking. Southwick and Charney (2012) assert that resilience is strongly associated with cognitive flexibility as it helps to reframe adversity or stress in a more positive light and can moderate the severity of distress. Campbell-Sills et al. (2006) emphasise that during an encounter with hardship, having more flexible thinking and increased behavioural options may enhance the personal resources of resilient individuals.

Cognitive flexibility is situated in executive functioning and is essential for higher mental function. Executive functions include working memory, attention, impulse control, response inhibition, planning, judgement, and decision making (Baddeley, 1996; Rubinstein et al., 2001; Stuss & Alexander, 2000), and is largely mediated by pre-frontal cortical function (Logue & Gould, 2014). This group of processes is considered to represent higher-order cognitive abilities that enable individuals to orient towards the future, demonstrate self-control and successfully perform goal-directed behaviour (Baddeley, 1998; Stuss & Alexander, 2000), which are necessary cognitive skills for pilots. Any change in the relevant neurotransmitter systems can have a grave impact on executive function and reduce human performance in adjusting and adapting to any change. Logue and Gould (2014) explain that these complex behaviours work together to regulate cognition in response to changes in the environment.

Hildebrandt et al. (2016) make the important point that cognitive flexibility is likely to be critical in a threatening situation, where ongoing cognitive processes need to be inhibited and resources shifted to processing the current threat. This process involves two central components: (1) 'inhibition'—the ability to override proponent responses and to inhibit the processing of irrelevant material and (2) 'shifting', which involves activating relevant material and disengaging from irrelevant material by switching back and forth between mental sets (Miyake et al., 2000). Miyake et al. (2000) add that this flexibility depends on strong executive control, particularly in terms of efficient shifting of attentional and cognitive resources to the processing of new information while exhibiting inhibition of the previously relevant information. Genet and Siemer (2011) summarise that highly resilient people obtain cognitive processes that promote flexibly attending to, and disengaging from, emotional material, which is essential for adaptive responses in a threatening situation.

Bonanno and Burton (2013) suggest that people respond to stressful events in different ways, depending on the event and the regulatory strategies they choose. They also identify three key components of flexibility: 1) how we read the situation, or context sensitivity; 2) a repertoire of behaviours; and 3) the ability to regroup using corrective feedback. The underlying idea is that there is not a right or perfect way to cope with stressors as it all depends on the situation. Therefore, it is more important for a pilot to be cognitively flexible in adapting behaviour across different situations than having the ability to use any single strategy.

Martin and Rubin (1995) and Martin and Anderson (1998) contend that cognitive flexibility refers to a person's (a) awareness that in any given situation there are options and alternatives available; (b) willingness to be flexible and adapt to the situation; and (c) self-efficacy or belief that one has the ability to be flexible. Martin and Anderson (1998) further explain that cognitively flexible people exhibit better acknowledgment of possible behavioural adjustments based on situational factors than those who can see only one proper or correct behavioural response. These types of people are also willing to try new ways of communicating, to encounter unfamiliar situations and to adapt their behaviour to meet contextual needs. Even though people may be aware of alternative modes of behaviour in a given situation and are willing to be flexible, they also need to believe that these are self-efficacious in bringing out the desired behaviour (Bandura, 1977, cited in Martin & Rubin, 1995).

There is a strong connection between positive emotion that can broaden cognitive flexible ability and cognition that can influence emotion. Ochsner and Gross (2007) suggest that cognitive flexibility is linked to the regulation of emotion. This is because humans use a range of cognitive processes to regulate and control their emotional states (Eysenck 2012). The ability to flexibly attend to and disengage from emotional material is crucial for effective emotional regulation (Gross, 2008). Genet and Siemer (2011) suggest that promoting effective emotion regulation (ER) will also increase cognitive flexibility, which is linked to improved resilience. ER refers to the ability to effectively control one's emotions via a wide range of strategies to influence which emotions one has, experiences, or expresses (Gross, 2001). Gross (2008) advises that cognitive flexibility with effective material or 'flexible affective processing' may be a critical process underlying resilience.

In summary, cognitive flexibility is predicted to be the central control of the cognitive process underlying a pilot's resilience ability. Cognitive flexibility assists a range of other executive functions to engage relevant and disengage irrelevant information during the occurrence of an unexpected situation or constantly changing environment in a flight. Being flexible in the thinking process will generate variable options for pilots to deal with distress and regulate negative emotions when under pressure. Regulating emotion, in turn, will also enhance cognitive ability as the individual restores a broader mindset. Cognitively flexible individuals will adapt to any adverse situations and correct their course by using appropriate behaviours. Consequently, the cognitive flexibility process is hypothesised to help the pilot regain control over an unexpected situation because their strong executive control will allow them to think quickly even in an encounter with an unexpected crisis.

2.6.2 Active, Approach, Problem-focused or Task-oriented Coping

Stress coping is one of the leading human factors in safety-critical occupations, which include pilots and air traffic controllers, surgeons and surgical teams, and anaesthetists (Flin & O'Connor, 2017). People who work in these occupations have to tolerate many types of physical, physiological, and mental stressors (e.g., fatigue, infections, shift work, conflict in the workplace) that cause their non-technical skill performance to diminish. Flin and O'Connor (2017) assert that the preferred coping strategies of an individual can indicate to what extent they will experience stress. To that end, the coping style they use can either strengthening or reducing their non-technical skill performance in maintaining safety, health, and wellbeing throughout their long career journey.

Resilience and coping are related constructs that are processes or competencies of resilience viewed as important means of coping with adversities or threats (Leipold & Greve, 2009). Rutter (2007) proposes that personal agency or coping strategies can be mediated mechanisms giving rise to resilience. For this reason, attention needs to be paid to mental operations as well as to individual traits or experience because these are important factors giving rise to resilience. Southwick et al. (2005) assert that active coping strategies—for example, taking active steps to address stressors; and planning, problem solving or directing attention to positive thoughts—are linked to a higher capacity to handle stress as they help to enhance effective coping skills. Coping reactions can be built up and differentiated from the requisite condition of previous developmental processes. Leipold and Greve (2009) explain that competence in coping must develop from the ability to master challenges and learning to deal with stress. Simply put, successful future development depends mainly on how effectively a person can manage current stresses and challenges, and whether coping ability is activated that makes ones feel competence in responding to later stressors.

2.6.3 The Definition of Coping

Coping refers to specific cognitive processes and behavioural efforts made to master, reduce, or tolerate internal and/or external demands for the purpose of dealing with stressors or threats (Folkman, 1984, 2013; Folkman & Lazarus, 1980; Folkman

& Moskowitz, 2004; Lazarus & Launier, 1978; Pearlin & Schooler, 1978). The coping process involves cognitive, behavioural, and emotional responses; hence, this process begins when an individual appraises a situation as harmful, threatening, or challenging (Folkman, 2013).

According to stress and coping theory (Folkman & Lazarus, 1980; Lazarus, 1966, 1988; Lazarus et al., 1984) coping is assessed by the degree of the individual's perceived threat in a specific situation ('primary appraisal'). This activates the subjective perception of personal resources, coping strategies and social resources that can be used to deal effectively with a situation ('secondary appraisal'). Pearlin and Schooler (1978), Billings and Moos (1981) and Steinhardt and Dolbier (2008) consider that habitual coping strategies can moderate the effect of stressful and threatening events on functioning and enable an individual to successfully cope with a stressful situation. Roth and Cohen (1986) suggest that there are three main factors important for evaluating coping effectiveness: (1) the point in time at which effectiveness is evaluated; (2) the controllability aspects of the stressful situation; and (3) the fit between coping style and certain demands of the stressful situation (p. 816). Therefore, coping styles are believed to predict variance in resilience. People may use active, emotion-focused or avoidance coping strategies to deal with a stressor that exceeds their resources or endangers their wellbeing.

2.6.4 Types of Coping Strategy

Carver (2011) explains that the coping concept is very broad but can be broken down into two main constructs: emotion- and problem-focused coping (Lazarus & Folkman, 1984); and approach and avoidance coping (Roth & Cohen, 1986; Skinner et al., 2003). These types of coping differ in how a person appraises stressors and the amount of personal resources available for them to gain control during a stressful encounter. Based on these two coping concepts, researchers categorise coping strategies in three ways: problem or approach; emotion; and avoidance coping strategies. These three main coping strategies are discussed separately in the ensuing sections.

According to Holahan et al. (2017), problem-focused or approach coping is an adaptive coping style, whereas emotion-focused or avoidance coping strategies are maladaptive coping styles. Holahan et al. (2017) also explain that adaptive coping style refers to cognitive or behavioural efforts to manage stressful conditions as well as attempting to reduce the adverse effects of stressors, while the maladaptive coping style refers to the denial response to stress. When researchers discuss active coping strategies (Easterbrook, 1959; Folkman, 1984; Kahneman, 1973; Lazarus et al., 1980) as one of the adaptive coping styles, this type of coping strategy is also referred to as approach (Roth & Cohen, 1986), problem-focused (Lazarus & Folkman, 1984), task-oriented (Endler & Parker, 1999) or engagement coping (Skinner et al., 2003). Maladaptive coping styles are also referred to as avoidance (Roth & Cohen, 1986), disengagement (Skinner et al., 2003), emotion-focused (Lazarus & Folkman, 1984) or emotion-oriented coping (Endler & Parker, 1999).

2.6.4.1 Emotion-oriented Coping

Emotions play a vital role in all types of coping strategy because they signal what a person intends to do when experiencing different stressors. Appraisal generates emotions, whether positive or negative, and can drive people's fight or flee response (Lazarus, 1991). In other words, people appraise a stressful situation as uncontrollable/unchangeable or controllable/changeable, and whether it exceeds their personal coping resources, which include psychological, spiritual, social, environmental, and material resources, before deciding which coping strategy they will employ. Therefore, emotion-focused coping aims to regulate one's emotional state or reduce tension caused by a threat through either denial or changing one's attitude towards a threatening situation (Folkman, 1984; Folkman & Lazarus, 1980; Kahn et al., 1964).

Emotion-focused coping helps to facilitate problem-focused coping if a person sees the situation as something controllable. Carver (2011) and Kitano and Lewis (2005) explain that emotion-focused coping provides an opportunity for the individual to deal with stressors in a calm manner, having self-control and giving a positive reappraisal (creating positive meaning by reframing) to prevent, minimise or reduce distress. Some researchers consider that, in theory, the effectiveness of problem-focused efforts depends largely on the success of emotion-focused efforts (Easterbrook, 1959; Folkman, 1984; Kahneman, 1973; Lazarus, 1966; Maloney et al., 2014; Sarason, 1972). Folkman (1984) asserts that a first reaction to any stressful situation is emotion-centred (calm down first!), which is a permit to a problem-oriented clarification (i.e., if co-pilot has a conflict with a captain). Folkman (1984) explains that in most stressful encounters, problem-focused coping will be accompanied by emotion-focused coping as it is important to at least have some control over one's emotions. Furthermore, Lazarus et al. (1980) state that those positive emotions can facilitate effective problem-focused forms of coping as they help to preserve a tolerable internal state when trying to manage, and perhaps alter, a threatening situation. Otherwise, heightened emotions will interfere with the cognitive activities necessary for problem-focused coping.

Conversely, emotion-focused coping can also lead to negative outcomes if a person uses negative emotion-focused strategies such as self-blame, blaming others, feeling anxious or negative self-talk to deal with stressors that seem to be uncontrollable (Carver, 2011; Dubow & Rubinlicht, 2011). These coping methods can lead to distancing and avoidance behaviours when exposed to stressful situations, as discussed in Section 2.5.3.4.

2.6.4.2 Task-oriented Coping

Some researchers claim that one of the main components of resilience is active coping ability (Anthony, 1987; Kumpfer, 2002), also known as approach, engagement, problem-focused or task-oriented coping (Carver, 2014). By definition, this type of coping strategy refers to efforts directed at solving, managing, or improving a problem causing distress (Folkman, 1984; Folkman & Lazarus, 1980; Kahn et al., 1964). This focuses on modifying the stressors or changing the situation by using strategies of accepting responsibility, gathering information, planning, decision making, problem solving, resolving conflicts or being resourceful in seeking help from others (Folkman, 1984; Kitano & Lewis, 2005). It also includes efforts directed at acquiring resources (e.g., skills, tools, knowledge) to help deal with the underlying issue, incorporated into instrumental, situation-specific, task-oriented actions (Folkman, 2013).

A person who has excellent problem-solving skills will display the ability to 1) be interested and motivated to solve problems through a generalised cognitive–affective–behavioural response set; 2) accurately analyse and identify the problem; 3) generate a wide variety of possible solutions; 4) consider the consequences of each possible solution and consider all possible resources; 5) choose the best solution; and 6) implement the best solution and verify the results to learn more effective strategies for any problems that may occur later (D'Zurilla & Nezu, 1990; Janis & Mann, 1977). Boerner and Jopp (2010) point out that individuals can use active, problem-solving efforts that aim to improve or bring an end to an adverse situation while making internal adjustments to remain resilient.

Folkman et al. (1986) found that their research participants used more problem-focused forms of coping in encounters they appraised as changeable, and more emotion-focused forms of coping in situations they viewed as unchangeable. For example, if a person disagrees with their supervisor over a particular goal, they can attempt to convince the supervisor to change the goal; otherwise, they have to manage their own emotions to accept the goal that cannot be changed in an effort to achieve a favourable outcome (Folkman, 1984). MacNair and Elliott (1992) found that study participants' perceptions of their own problem-solving skills were associated with the consistent use of certain coping strategies. Those who perceived themselves as having effective problem-solving skills reported more problem-focused coping and less emotion-focused coping in reaction to stressful events over time.

Researchers differ in their use of terms to describe this type of coping method, yet describe similar characteristics when referring to how a person uses this coping style to achieve the corresponding outcome. To retain consistency and because the *Coping Inventory for Stressful Situations* (CISS) questionnaire uses the term 'task-oriented coping', the researcher adopts this term when discussing active coping methods throughout this thesis.

2.6.4.3 Avoidance-oriented Coping

An avoidance-oriented (also called disengagement) coping style regulates emotions and behavioural efforts to distance, escape or deny, for the purpose of avoiding dealing with stressful demands (Kitano & Lewis, 2005; Penley et al., 2002). This involves activities and cognitions aimed at avoiding a stressful situation that can be of a distraction or social diversion nature. Needless to say, most research (Bartone et al., 2017; Blalock & Joiner, 2000; Healy & Mckay, 2000; Holahan et al., 2005; Koeske et al., 1993) reveals no positive outcome from utilising avoidance coping strategies in the long term; task-oriented coping is well known as the most effective adaptive response to stress for resilient individuals.

However, researchers (Carver, 2011; Lazarus, 1983; Roth & Cohen, 1986) focusing on 'approach–avoidance' theory point out that avoidance coping strategies might be beneficial in the short term during the initial period of encountering stress when emotional resources are limited. Roth and Cohen (1986) explain that this strategy can serve to reduce stress and anxiety and allow for gradual recognition of threat, and that the minimal use of this type of coping method can lead to increased hope and courage, especially if some stressors persist over an extended period. However, there are potential costs to overusing avoidant strategies: Carver (2011) explains that avoidance coping strategies are ineffective in the long term when the stressor confronting the person poses a real threat that they will have to face eventually. Carver (2011) also asserts that with some stressors, the longer they are avoided, the more difficult and urgent the problem becomes. Roth and Cohen (1986) also infer that avoidance coping can interfere with appropriate action towards solving stressors.

In summary, highly resilient people demonstrate competence in using adaptive coping strategies to manage ongoing threats and stress that may threaten their safety. The active coping style approach supports people to actively seek solutions to solve any issues that may arise. Problem- and emotion-focused coping strategies are both functions of an active coping style as they often assist each other during the coping process to facilitate a favourable outcome, but only in the case of a positive emotion. Avoidance coping strategies can be used for a short period for people to recognise the threat but become ineffective in the long term. A pilot who exhibits active coping skills is hypothesised to be more resilient in facing a threat or stress and thus delivers safer flight outcomes.

2.7 Level of Experience as a Predictor of Resilience

Multiple reviews of the literature show longer work experience improves one's resilience capability. Reviews of the health professions (Acker, 2010; Gayton & Lovell, 2012; Gillespie et al., 2007, 2009; Larabee et al., 2010; Moore et al., 1996; Palma-García & Hombrados-Mendieta, 2014) indicate that work experience has a significant correlation with resilience level. Gillespie et al. (2007, 2009) found that Operation Room (OR) nurses' resilience level increased with more work experience in the OR. These OR nurses explained that they were often exposed to situations such as working with surgeons and anaesthetists who were demanding and engaged in explosive or abusive behaviour; thus, they had to develop coping strategies that facilitate adaptation (Gillespie et al., 2007). A study by Gayton and Lovell (2012) compared groups of experienced paramedics and paramedical students, finding that the qualified paramedics showed much higher resilience levels than the paramedical students regardless of the number of years of experience as a qualified paramedic. Gayton and Lovell (2012) explain that qualified paramedics exposure to traumatic experiences such as fatal car accidents improved their resilience significantly; however, paramedical students have not yet experienced this type of work-related trauma.

Gillespie et al. (2007) point out that with increased work experience comes increased ability to manage workplace stress. Further, numerous studies (Chan & Morrison, 2000; Moore et al., 1996; Tourangeau & Cranley, 2006) report that years of experience can influence stress management for nurses across various contexts. Acker (2010) also found that social workers with higher work experience developed coping strategies and perceptions of competence in managing their stress. Nurses are also identified as engaging in more problem-focused approaches (Gillespie et al., 2007; Wong et al., 2001) and less escape-avoidance coping (Chang et al., 2007; Wong et al., 2001) to manage their stress.

When it comes to aviation, especially in the flying context, resilience is also expected to be improved with increasing flying experience. However, pilots' flying experience can be assessed from multiple angles including number of years of experience—as specified in the above studies—or total flying hours; that is, the number of hours flown in a year differs between pilots. Also, flying experience is not comparable to age as some pilots start flying at a very young age while others start when they are older. Therefore, when discussing resilience with respect to flying experience, this study forms hypotheses based on (1) the number of years of flying experience; (2) the number of total flying hours; and (3) age, to determine whether any of these factors might be associated with resilience as found in other studies. It is thus hypothesised that both more years of flying experience and more hours of flying experience will increase resilience capability. Additionally, age is hypothesised to improve resilience capability.

2.8 Workload, Stress and Resilience

Higher workload is one of many factors that arouses stress when an individual must insert greater capability to sustain performance during increasing work volume; however, the demand to adequately respond to a high workload usually outweighs one's coping resources, resulting in physically and mentally strain (Staal, 2004). Many research studies in the health professions find that workload is one of the main factors causing stress in the workplace as this group of people has to work long hours and under time pressure, as well as being rostered with shift work that frequently includes night shifts (Birhanu et al., 2018; McCann et al., 2013; McVicar, 2003; Stordeur et al., 2001). Matthews et al. (2000) investigated tasks including vehicle driving, industrial work and military operations and identified that tasks that require higher performance are frequently stressful. Matthews et al. (2000) explain that these tasks generally impose a high workload, time pressure or the likelihood of failure and thus may be intrinsically demanding to perform. Neubauer et al. (2016) also point out that 'high-workload tasks are typically very cognitively demanding and frequently stressful to the person performing them' (p. 193). Operators who work in a complex work system always face complex tasks; thus, poor cognitive performance may increase the chance of human error and critical subsequent consequences (Ghalenoei et al., 2021).

In the flying environment, workload often refers to the mental demand to complete tasks inside the cockpit, especially during the operation of flight. Numerous researchers have attempted to emphasise workload in relation to stress that affects pilots' situational awareness (Durso & Alexander, 2010; Jensen, 1997; Tsang &

Vidulich, 2006; Wickens, 2002). These studies indicate that higher workloads increase stress, reduce situation awareness and cause fatigue in pilots. However, the researcher could find no literature on the relationship between workload, stress and supportive factors that assist in promoting pilots' resilience. This raises the question of which resilience factors might play a mediating role to lessen pilots' stress levels resulting from a high workload. Therefore, high workload in this research 'refers to' and 'measures from' the number of annual flying hours, which is calculated from the number of hours the professional airline pilot spends operating an aircraft as well as their rank as captain or co-pilot.

The best evidence for a resilient pilot would come from the perfect study group of pilots who had experienced an adverse event during an emergency flight in which they encountered a significant high-risk condition and still managed to safely return the aircraft to the ground. While this specific population is very rare and difficult to access, a suitable proxy might be a group of professional airline pilots who regularly perform stressful tasks under time pressure, high workload, and other severe conditions with extremely high responsibility. This approach could help to identify whether resilience capability can be altered by higher workload or more responsibility.

2.9 The Role of Age and Gender in Resilience

Demographic factors should be taken into consideration when discussing individual resilience, as Bonanno et al. (2007) point out that age, gender, race and ethnicity are associated with resilience outcomes. Specifically, age and gender are most frequently debated in regard to whether they predict the level of resilience, with no consistent evidence presented in the literature. Some studies find that as people age, they become more resilient (Afshari et al., 2021; Campbell-Sills et al., 2009; Leipold et al., 2019), yet others indicate a negative relationship between resilience and age (Beutel et al., 2009; Gillespie et al., 2009; Lamond et al., 2008). Moreover, Rahimi et al. (2014) found that males in their study were more resilient than females while Isaacs (2014) and Vinayak and Judge (2018) found the opposite.

2.9.1 Gender Differences in Perceived Stress

Research studies on stress aim to determine whether males and females perceive various types of stress differently. Many studies find that females perceive higher stress or distress than do males (Bore et al., 2016; Brougham et al., 2009; Nolen-Hoeksema, 1987; Rahimi et al., 2014). However, Davis et al. (2011) point out that men and women can perceive stress of the same magnitude, but it depends on the types of stressor they are dealing with at the time. For example, when Almeida et al. (2002) compared between men and women on how these two groups perceived daily stress, they found that men reported stressors related to work and financial events, whereas women reported stressors related to family and network events. Davis et al. (2011) found that gender differences in stress tended to disappear when the genders were well-matched in employment status and occupational prestige. A similar finding was reported by Walton and Politano (2014), where gender differences were not apparent in the degree of stress indicated by pilots. It can be summarised that males and females perceive various types of stress differently, but matching employment status and occupational prestige can reduce this difference.

2.9.2 Gender Differences in Cognitive Flexibility

Research studies on gender differences in cognitive flexibility report mixed results. In a study of 378 university students aged 18–65 years, the men demonstrated higher cognitive flexibility than the women (Roothman et al., 2003), while the opposite was reported in a study of pre-service teachers (Hanife, 2018). Many studies of college students report no gender difference in cognitive flexibility (Bertiz & Karoglu, 2020; Kercood et al., 2017; Kim & Omizo, 2006). A research study by Shields et al. (2016) compared acute stress and cognitive flexibility between genders using the Wisconsin Card Sort task under controlled conditions and found that acute stress impaired cognitive flexibility in men but did not significantly affect women. Shields et al. (2016) specify that the biological mechanism(s) underlying these observed effects is unclear. Shields et al. (2016), along with Kalia et al. (2018), also found that acute stress increased perseveration (one of the cognitive flexibility functions) in male but not female participants. The results from other studies do not strongly support either gender having higher cognitive flexibility. Thus, the hypothesis testing in this research will remain neutral with gender differences on cognitive flexibility.

2.9.3 Gender Differences in Selection of Coping Method

The findings from many studies are inconsistent in regard to gender differences in coping efforts. Some studies found that men were more likely to use problem-oriented coping than women (Folkman & Lazarus, 1980; Higgins & Endler, 1995) or avoidance-oriented coping (Berzonsky, 1992) while some found that women were likely to use more emotion-oriented and avoidance-oriented coping than men (Billings & Moos, 1981; Blalock & Joiner, 2000; Brougham et al., 2009; Pearlin & Schooler, 1978). In other, studies there was no difference between males' and females' efforts towards problem-focused coping (Berzonsky, 1992) or emotion-oriented coping (Folkman & Lazarus, 1980; Higgins & Endler, 1995). In contrast, a quantitative review of 50 studies by Tamres et al. (2002) finds that when people are asked how they cope with particular types of stressors, women generally report using different types of coping strategy from men, including those categorised as problem-focused or emotion-focused strategies. Davis et al. (2011) emphasise that coping has been conceptualised as a dynamic process and that the nature of stressors influences the selection of coping responses, therefore, to identify any gender differences in coping efforts, assessments should be based on the same types of stressors.

With respect to the mixed results in the literature, women are not specifically identified as using more 'positive' or 'negative' emotion coping strategies; thus, it cannot be assumed that greater application of emotion-oriented coping will increase engagement in avoidance-oriented coping strategies. Therefore, this research hypothesises that men will adopt more task-oriented coping strategies while women will adopt more emotion-oriented coping strategies when in encountering stress, while the genders are assumed to adopt a similar degree of avoidance-oriented coping strategies.

2.9.4 Age Differences in Perceived Stress

Aldwin and Yancura (2011) state that 'stress and coping processes are affected by age, and aging processes are influenced by stress and coping' (p. 263). Aldwin (1991) proposes that stress forms a context for development in adulthood. Research on nurses (Moore et al., 1996; Shields & Ward, 2001) has shown that age can be one of the factors that influences coping and stress management behaviour. Moore et al. (1996) found that older nurses (>51 years) demonstrated the lowest level of stress and explained that older nurses can cope better with workplace stress and adapt more effectively to constant changes. Similar results were also reported for social workers when Acker (2010) identified that age can play a part in managing stress levels. Studies by Epstein (1991) and Janoff-Bulman (2004) show that stress—especially major stressors, trauma, or loss—creates a condition of uncertainty that can force individuals to re-examine their assumption systems and challenge them to develop new resources to cope with future stressors (Aldwin, 2007).

Aldwin and Yancura (2011) identify that those four categories of stressors are most commonly assessed because they are relevant to the experience of stress in late life. These are trauma, life events, daily stressors, and chronic stress. In multiple studies, older adults typically reported fewer life event stressors (Chiriboga, 1997; Rabkin & Struening, 1976), and fewer daily stressors than did younger people (Aldwin et al., 1996; Almeida, 2004). However, in regard to traumatic stressors, Weintraub and Ruskin (1999) did not find strong evidence that older or younger adults differed in regard to development of PTSD (post-traumatic stress disorder). With regard to the chronic type of stress, there is also no strong evidence that this is more common in any age group; nevertheless, in the study by Aldwin et al. (2002), middle-aged adults reported more chronic stressors than did young or old adults. If this research emphasises daily stressors—that is, work-related stress in the group of airline pilots and related stress (university and flight training) in the group of aviation students—then it can be inferred that those older adults will show lower stress than younger adults.

2.9.5 Age Differences in Cognitive Flexibility

Cognitive flexibility is an executive function that develops and then degenerates over the lifespan. Dajani and Uddin (2015, p. 6) review a series of studies (Anderson, 2002; Cepeda et al., 2001; Dick, 2014; Hunter & Sparrow, 2012) and find that:

> cognitive flexibility skills begin to develop in early childhood with a sharp increase in abilities between 7 and 9 years of age, then become largely mature

by 10 years of age, but skills continue to improve throughout adolescence and into adulthood, while reaching their peak between the ages of 21 and 30.

Various research also yields the consistent finding that cognitive flexibility deteriorates with age (Head et al., 2009; Mell et al., 2005; Peltz et al., 2011; Rhodes & Kelley, 2005; Wecker et al., 2005; Wilson et al., 2018), which raises the question of at what age this ability begins to decline. A review by Salthouse (2009) points out variable findings regarding the age at which cognitive ability starts to decline. Some studies propose that cognitive ability remains relatively stable throughout adult life and then starts to decline at 70 years old or later (Aartsen et al., 2002; Lezak et al., 2004) while others find the decline begins at 60 (Plassman et al., 1995), 55 (Ronnlund et al., 2005) or as early as 45 years of age (Singh-Manoux et al., 2012). However, research by Schaie (1989, p. 191) provides the clearest explanation, that ‘most abilities tend to peak in early midlife, plateau until the late fifties or sixties, and then show a decline, initially at a slow pace, but accelerating as the late seventies are reached’.

With reference to the above findings, this research assumes that cognitive flexibility skills increase with age because additional training and more flying experience will support the development and expansion of this ability. However, as the specific age at which this ability starts to decline is not clear, this ability should develop, expand, and be maintained as age and flying experience increase.

2.9.6 Age Differences in Selection of Coping Method

Aldwin (1991) and Aldwin et al. (1996) point to several studies that found that older adults used less escapism or avoidance coping, but a similar or higher level of problem-focused coping as younger adults (Aldwin & Revenson, 1985; Blanchard-Fields et al., 1991; Irion & Blanchard-Fields, 1987). In some studies, younger people were found to use the emotion-oriented style more often than older people (Brudek et al., 2019; Kruczek et al., 2020). Notwithstanding this, McCrae (1982) suggests that coping strategies used by different-aged adults largely depend on what type of stressors they encounter. Aldwin (2007) also suggests that people in different age groups are likely to use problem-focused coping for situations that seem controllable and emotion-focused coping for uncontrollable situations; therefore, the focus should be on coping efficacy, which indicates whether an individual uses effective coping strategies for a particular situation. Aldwin (1991) believes in the intrinsic development process or experience, as she explains that when people age, they are exposed to a variety of problems, which helps them to learn which types of coping strategy are ineffective and which can support them to achieve their goals in various situations.

Given that the selection of a coping strategy largely depends on the type of stressor one experiences, and that participants in the current research have experienced similar types of stressors, older participants should engage in more task-oriented coping because they have experienced more adaptive coping strategies; whereas younger participants should engage in more emotion- and avoidance-oriented coping because they do not have enough experience to choose more adaptive coping strategies.

In summary, the review of research studies on age and gender differences in perceived stress, cognitive flexibility, and selection of coping strategies in relation to resilience capability yielded inconsistent findings. The diverse results were influenced by differences in the focal group under study, situation, or conditions under ones' studies. This raises the question of what approach might help to prepare pilots of different ages and gender to ensure they the same, or at least, a similar level of resilience capability to cope well in the face of an emergency? The approach of 'stress inoculation' has been found to bring people with different age and gender to the same level of how they would respond to stress. Details about this approach are discussed in the following section.

2.10 Stress Inoculation Contribution to Resilience

'Stress inoculation' is comparable to a vaccine that induces immunity against disease as it forms immunity against later stressors (Rutter, 1993). Southwick and Charney (2012) explain that this phenomenon occurs when the individual develops an adaptive response and higher-than-average resilience in the face of the negative effects of subsequent, uncontrollable stressors. For people such as medical and military personnel, aviators, police officers, firefighters, and rescue workers who work in conditions where performance in the face of adversity is required, controlled exposure to stress-related cues is a key feature of resilience training (Meichenbaum, 2017; Stetz et al., 2007). Feder et al. (2010) point out that an adaptive response to stress in the future could be promoted by exposure to mild or 'manageable' stress during the development process.

David et al. (2009) state that 'stressful experiences that are challenging but not overwhelming appear to promote the development of arousal regulation and resilience' (p. 1). Studies of the neurobiology of resilience by Russo et al. (2012) and the psychobiology of resilience by Feder et al. (2009) agree that reduced behavioural and hormonal responses to stress later in life are found to be associated with early exposure to manageable stressors in rodents ('stress inoculation'). Therefore, these researchers assume that exposure to manageable stressors during development is associated with more adaptive coping with stress during adulthood. Furthermore, in a study by Mortimer and Staff (2004), adults who had been exposed to work stress in their adolescent years had fewer deleterious mental health effects from work-related stress during their adulthood. Stress inoculation findings in research studies raises the question of whether flight training might also be considered a stress inoculation activity for novice pilots to develop their resilience ability at an early stage. The various stressors during the training process might also prepare them for encounters with danger in a high-risk situation at some stage in their flying career.

2.11 Literature Review Summary

Stress is a state of tension in a person and resilience is one effective way of coping with stress. Stress may be inevitable, but resilience allows people to adapt, which is especially important when the person who may be suffering stress is in a job that demands high performance. This refers particularly to pilots, who are mandated by ICAO to preserve their proficiency in their non-technical skills to ensure aircraft safety even when they feel under stress with time pressure, high workload, the fast-changing environment, or even personal issues. Pilots can become vulnerable, as can people in other occupations; thus, they need to be resilient to maintain their non-technical skills and persevere with whatever adverse events they might encounter when are on duty.

After reviewing definitions of resilience in relation to human psychology, psychobiology, pilot non-technical skills and safety, no specific description emerges. Several resilience definitions depend on current research and researchers' perspectives regarding whether they perceive resilience as a personality trait quality, an ongoing development process or an outcome after facing adversity. Based on evidence in the literature, the researcher hypothesises that pilots' resilience capability is an ongoing process that can be developed over time. Therefore, the researcher adopts this study's scope and direction from the viewpoint of the resilience process as it appears to be educable and trainable for pilots' non-technical skills. Consequently, the scope, guidelines and direction might lead to the discovery of how resilient pilots' characteristics can be defined in the context of aviation safety.

Current resilience research progresses beyond viewing nature (genetic factors) and nurture (non-genetic factors) as definitive factors alone, to identification of how an individual's inherent capability responds to extrinsic factors (the gene–environment interplay). The literature shows that resilience is a basic human psychobiological operation, as mental and physical functions are interrelated when helping a person fight adverse events. For this reason, researchers across disciplines work collaboratively to clarify the operation of resilience and identify key factors that promote resilience capability. The current study aims to identify how resilience operates in the high-risk occupation of the airline pilot in the hope that this knowledge will make a safety contribution to the aviation industry in the long term.

The resilience research methods commonly specify the variability of risk factors that exist in different study contexts in order to identify the protective/ supportive factors that match in fighting against those risks. With respect to the design of the current study of resilience in the aviation safety environment, the researcher has identified risk factors that may impair pilots' non-technical skills, including high workload, time pressure, and the responsibility to preserve one's own and other people's lives. This raises the question of what trainable or educable protective/ supportive factors would help fight against these risks and promote pilots' non-technical skills to minimise or even potentially eliminate risks and enhance flight safety.

The two chosen psychological resilience factors (cognitive flexibility and task-oriented coping strategies) are predicted to be protective factors that enhance pilots' non-technical skills in situations where safety is critical. Cognitive flexibility is an executive function that supports an individual to think quickly in a dangerous situation. It generates a variety of options for the individual to select the best way to cope with adverse events. An individual with strong executive control will behave flexibly so that they can choose appropriate behaviours to counteract stress. Effective cognitive flexibility is empowered by positive emotions, which in turn are influenced by cognitive ability. Active coping is the ability to plan and problem solve, which prepares an individual's perceptions, emotions and behaviours to adapt to a constantly changing environment. A resilient individual is one characterised by coping styles ranging between problem-focused and emotion-focused coping. Several studies provide evidence that resilience is associated with the ability to employ a variety of coping strategies in a flexible manner depending on the specific challenge; and the use of corrective feedback to adjust those strategies. Pilots who actively cope with stress are likely to display resilience when they encounter hardships or adverse events.

In addition to factors that may contribute to resilience, individual and demographic variables also play a role in the prediction of resilience. Age and gender are frequently discussed in resilience studies as many researchers propose that resilience comes with age and that there are gender differences in perceived stress and employment of coping strategies. It is essential that gender and age differences (if they exist) are acknowledged in subjects undertaking flight training so that appropriate strategies can be developed.

In conclusion, stress inoculation could become a key feature of resilience training, especially in careers that require high performance in the face of adverse events. As found in many studies, exposure to manageable stressors during the development process can improve adaptive responses to stress. This emphasises that flight training is also resilience training because novice pilots are exposed to different kinds of stressor, and their level of cognitive flexibility will assist them in the selection of appropriate strategies to cope with hardships during the training period.

Resilience operation is far from understood despite the long history (50 years) of resilience research in human development. The current study adapts the principle of the stress coping process that helps people become resilient, to how to nurture pilot performance to handle risky and threatening situations no matter how stressful their job requirements. Cognitive flexibility and active coping strategies are two resilience factors hypothesised to support pilots' performance in high-risk situations and that need to be tested to identify whether they can minimise stress levels or improve a pilot's capability in regard to the ultimate goal of flight safety.

CHAPTER 3: METHODOLOGY

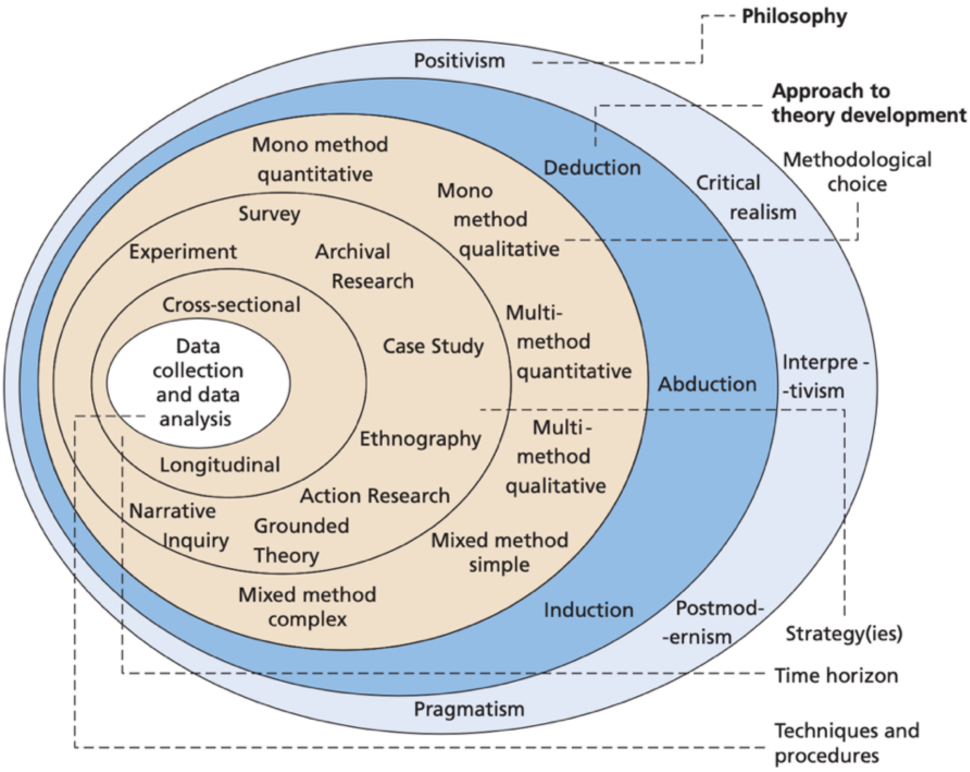
The research methodology includes general activities such as identifying the problem, reviewing the literature, formulating hypotheses, procedures for testing hypotheses, measurement, data collection, analysis of data, interpreting results and drawing conclusions (Singh, 2006). However, Ryan (2006) suggests that a methodology section should discuss the links between the researcher's philosophical stance on the topic and the methods, techniques and procedures used in a thesis. Ryan (2006) also considers that the methodology chapter should form a 'hinge' between the literature review section and the findings/discussion sections. Therefore, in this chapter, the researcher attempts to explain the research process used in this thesis on the basis of the philosophical perspective that led to the selection of the research methods employed.

The research process used in this study is best illustrated by Saunders et al.'s (2019) analogy of the onion, which has several important layers. Each layer starting from the outer part (philosophical perspectives) leads to an inner part, until the centre of the 'research onion' (data collection and data analysis) is reached, as shown in Figure 3.1.

The research onion diagram covers a broad scope, from the philosophy underlying the research question, which informs theory development leading to the methodological choice, strategy and time horizon that results in selection of data collection techniques and data analysis procedures. In addition, sampling techniques as well as their reliability and validity for the selected research strategy, must be taken into consideration when planning a research project. The research onion is comprised of many layers and each layer consists of many research options and strategies. In this section, the researcher will commence an introduction with different types of paradigms and research philosophies, then narrowing down to the components adopted in this research study. Additional key points that must be taken into consideration when planning research include the reliability and validity of research findings, and the sampling methods. These key points are discussed later in this chapter.

Figure 3.1

The Research Onion Diagram



Note. Adapted from 'Research Methods for Business Students' (8th edition., p. 130), by M. Saunders, P. Lewis, and A. Thornhill, 2019, New York: Pearson. Copyright 2019 by Mark N.K. Saunders, Philip Lewis, and Adrian Thornhill. In the public domain.

3.1 Paradigms and Research Philosophies

The word 'paradigm' was first used by philosopher Thomas Kuhn (1962) to refer to a philosophical way of thinking. Guba and Lincoln (1994) define a paradigm as a basic set of beliefs or worldviews that guides a research action or investigation. The research paradigm has significant implications for every decision in the research process, which includes the choice of methodology and methods, as this defines a researcher's philosophical orientation (Kivunja & Kuyini, 2017). Saunders et al. (2019) describe in the research onion diagram that there are five major philosophies which include positivism, critical realism, interpretivism, postmodernism, and pragmatism.

3.1.1 Positivism

Saunders et al. (2019, p. 144) clarify that when positivists conduct research, they use the 'strictly scientific empiricist method designed to yield pure data and facts uninfluenced by human interpretation or bias'. In other words, the researcher tries to remain neutral and detached from the research and data to avoid influencing the findings. A positivist also uses existing theory to develop hypotheses that can be tested, confirmed as a whole or in part, or refuted, which can lead to the further development of theory. Saunders et al. (2019) add that positivists create law-like generalisations by looking for causal relationships in data. These findings facilitate the creation of universal rules and laws that can explain and predict behaviour and events in a study group.

3.1.2 Critical Realism

A critical realist sees reality as external and independent, however, it is not directly accessible through our observation and knowledge of it (Saunders et al., 2019). In other words, to understand the world, the critical realist assumes that knowledge is experienced through sensations and events, which manifest the things in the real world rather than the actual things. Saunders et al. (2019) insert that those researchers who lean toward the critical realist philosophy, are looking for the underlying causes and mechanisms to provide an explanation for observable organisational events. Their research generally takes the form of an in-depth historical analysis of social and organisational structures to observe how it has changed over time (Reed, 2005). Reed (2005) also suggests that the critical realists' research method is not limited to statistical correlations and quantitative methods, but the wide range of methods is acceptable.

3.1.3 Interpretivism

Interpretivism was developed as a critique of positivism but from a subjectivist perspective (Saunders et al., 2019). Interpretivism studies people from different cultural backgrounds, under different circumstances and at different times to understand individuals' meanings in different social realities. Unlike a positivist who tries to create law-like generalisations that apply to everybody, interpretivism research focus on complexity, richness, multiple interpretations, and meaning-making in attempting to understand the social worlds and contexts. Crotty (1998) explains that in the shaping of an individual's interpretations and experiences of social worlds, the interpretivist emphasises the importance of language, culture, and history.

3.1.4 Postmodernism

Saunders et al. (2019) state that postmodernists go even further than interpretivists in their critique of positivism and objectivism. Aylesworth (2015) points out that the postmodernism paradigm is difficult to define as attempting to define this type of paradigm would violate the postmodernist perspective that there are no definite terms, boundaries, or absolute truth. This is because, from a postmodernist point of view, there is no objective and knowable truth. Kilduff and Mehra's (1997) explanation help to simplify that the goal of postmodern research is to challenge radically the established ways of thinking and knowing. Chia's (2003) explanation adds further that postmodernist research endeavours to give voice and legitimacy to the suppressed and marginalised ways of seeing and knowing that have been previously excluded.

3.1.5 Pragmatism

For the pragmatism paradigm, research generally starts with a problem and aims to contribute practical solutions that inform further organisation practice (Saunders et al., 2019). Saunders et al. (2019) explain that a pragmatist will consider theories, concepts, ideas, hypotheses, and research findings as the role they play as instruments of thought and action, and in terms of their practical consequences in specific contexts. The pragmatist does not follow a certain type of research method, but multiple methods can be adopted within one study. This is because, from pragmatists' worldviews, there are many different ways of interpreting the world and undertaking research, therefore, one single point of view may be inadequate to understand the entire picture (Saunders et al., 2019).

As the current research topic and research questions aim to investigate existing theories pertaining to whether cognitive flexibility and active coping strategies would improve the performance of pilots, as they do for other groups of people, the 'positivism' approach was adopted to guide the researcher to a suitable methodology to answer the research question. To adopt the positivism paradigm, the researcher aims to gather pure facts and uninfluenced results while remaining neutral and avoiding persuading the findings of this study. The researcher develops hypotheses from existing theories from other fields of research and applies them to the aviation discipline, which will lead to further development of theory in the aviation field. The researcher looks for the casual relationship in the collected data from both airline pilots and aviation students to help to create law-like generalisations. To achieve the research goal as the positivist researcher, the results or findings of this research should facilitate the creation of universal rules and laws that can explain and predict resilience ability in airline pilots and aviation students to a larger group.

3.2 Positivism and its Essential Elements

Creswell (2014) highlights that the choice of research approach (qualitative, quantitative, or mixed methods) utilised by a researcher depends substantially on their worldview. Rehman and Alharthi (2016) provide a comprehensible explanation: 'a paradigm is a basic belief system and theoretical framework with assumptions about 1) ontology, 2) epistemology, 3) methodology, and 4) methods' (p. 51). In this section, the positivist's assumptions about ontology, epistemology, methodology and method are discussed.

Ontology is a branch of philosophy that deals with the nature and structure of 'reality' (Guarino et al., 2009). It studies concepts such as existence, being, becoming and reality, as well as the basic categories of substances that exist and their relationships (Kivunja & Kuyini, 2017). With an ontological question, a researcher holds assumptions about reality, how it exists and what can be known about it (Rehman & Alharthi, 2016). It is these concepts, assumptions and propositions that help to orient the researcher's thinking about the research problem and its significance and that give rise to further study. Saunders et al. (2019) explain that in positivism ontology, a researcher observes things that are real, external, independent or one true reality.

Epistemology is 'the branch of philosophy that studies the nature of knowledge and process by which knowledge is acquired and validated' (Gall et al., 2003, p. 13). It focuses on 'the nature and forms of knowledge, how it can be acquired and communicated to other human beings' (Cohen et al., 2007, p. 7). The researcher is guided to certain epistemological assumptions that adhere to their ontological belief system. Rehman and Alharthi (2016) simplify this philosophical study concept as how we come to know something or how we know the truth or reality. For Saunders et al. (2019), epistemology from the 'positivist' viewpoint approaches the research method through observation and measurement and uses this approach to explain observations and predict outcomes.

The **methodology** is 'an articulated, theoretically informed approach to the production of data' (Ellen, 1984, p. 9 as cited in Rehman and Alharthi, 2016). Crotty (1998, p. 3) describes it as the 'strategy, plan of action, process or design' that informs one's choice of research methods. Ryan (2006) refers to methodology as a 'perspective' or broad theoretically informed approach to research, which stems from the researcher's epistemological stance or philosophical/political position. Grix (2004) states that 'research methodology is concerned with the discussion of how a particular piece of research should be undertaken' (p. 32). Rehman and Alharthi (2016) infer that the research methodology guides the researcher in deciding what type of data is required and which data collection tool is most appropriate for the purpose of their study.

The **method** is distinguished from the methodology. Long (2014) points out that methodology refers to the general logic and theoretical perspective (Bogdan & Biklen, 2007), while methods are specific strategies, procedures, and techniques for analysing and interpreting data (Bogdan & Biklen, 2007; Merriam, 2002). Crotty (1998, p. 3) describes methods as 'the techniques or procedure used to gather and analyse data related to some research question or hypotheses'. According to Saunders et al. (2019), research can employ a mono method, multi-method, or mixed-method for both quantitative and qualitative approaches.

3.3 Deductive Approach to Theory Development

When it comes to the 'approach to theory development' layer of the research onion, a positivist utilises the 'deductive approach' to evaluate propositions or hypotheses based on pre-existing theory (Saunders et al., 2019; Silverman, 2013). Snieder and Larner (2009) explain that a deduction forms expected results that allow a researcher to formulate hypotheses and use statistical analysis to test whether the results are at an acceptable level of significance. Therefore, the deductive approach generally starts with a theory that the researcher has developed from reading the academic literature; they then design research to test the theory. Kothari (2004) points out that the deductive approach begins with 'the general' then narrows down to 'the specific': the general theory and knowledge base are first established, and the specific knowledge gained from the research process is then tested against it.

According to Blaikie and Priest (2019), the deductive approach progresses through six sequential steps:

- A researcher puts forward a tentative idea, an assumption, an hypothesis (which is a testable proposition about the relationship between two or more concepts or variables) or a set of hypotheses that form a theory.
- A researcher uses existing literature or specifies the conditions under which the theory is expected to hold to deduce a testable proposition or number of propositions.
- A researcher then examines the assumptions and the logic of the argument that produced them: compares this argument with existing theories to see whether it offers an advance in understanding; if yes, then continue.
- A researcher tests the assumptions by collecting appropriate data to measure the concepts or variables and analyse them.
- If the results of the analysis are not consistent with the assumptions, the theory is false and must be either rejected or modified and the process restarted.
- If the results of the analysis are consistent with the assumptions, then the theory is temporarily corroborated.

Saunders et al. (2019) also assert that the deductive approach has three important characteristics: 1) it uses a highly structured methodology to facilitate replication that identifies all important issues to ensure reliability; 2) it is operationalised in a way that enables facts to be measured or quantifiable; and 3) the sample must be generalised, and the sample size must be sufficient. Therefore, the deductive approach has various advantages; for example, the concepts can be measured quantitatively by presentation in the form of numbers; the research findings may be generalised to a certain extent; and it possible to explain causal relationships between concepts and variables.

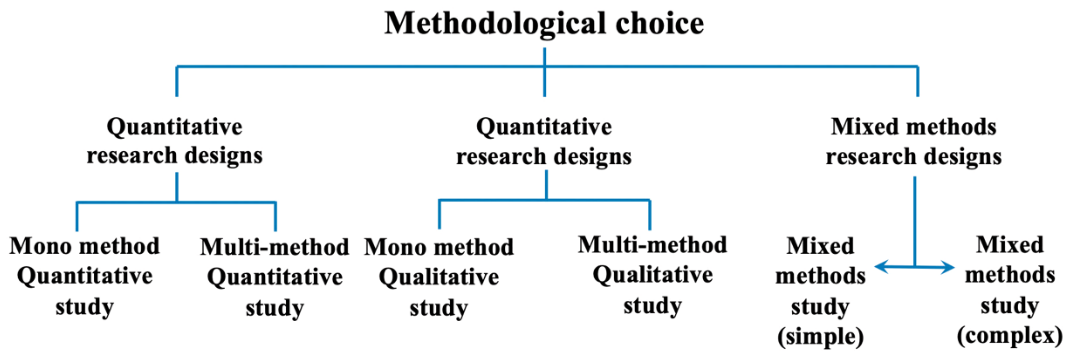
The researcher in the current study adopts a positivist philosophy or paradigm to explain the underlying logic behind this research question and then utilises a deductive approach to theory development, complemented by a positivist paradigm. By utilising the deductive research approach, the researcher is able to explore known theories regarding cognitive flexibility and active coping strategies, and form hypotheses to test if these theories are valid in the study of airline pilots and aviation students. The test results lead to either confirmation or rejection of the hypotheses. The selection of philosophy and approach to theory development facilitated progress towards the next most inner layer: methodological choice, research strategy and research time horizon. Saunders et al. (2019) call these layers the 'process of research design'.

3.4 Mono Method Quantitative–Methodological Choice

Based on Saunders et al.'s (2019) perspective on 'research methodological choices', there are six types of research method: mono method quantitative; mono method qualitative; multi-method quantitative; multi-method qualitative; mixed-method simple; and mixed-method complex, as shown in Figure 3.2. However, Saunders et al. (2019) advise that before adopting any of these research methods, a researcher should have a clear research question and objective for their study to ensure that the methodology they use will enable to achieve these. The researcher considered the objective of this research and the question to be addressed and considered data collection techniques and analysis procedures suitable for the timeframe available to meet the study objective: thus, a 'mono method quantitative' approach was adopted for both Study 1 and Study 2 presented in this thesis.

Figure 3.2

Methodological Choice Diagram



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The mono method involves a single data collection technique and corresponding analysis procedure. A researcher typically gathers just one type of information for their study, via either a qualitative research strategy such as interview followed by qualitative data analysis procedures; or a quantitative research strategy such as questionnaire followed by quantitative data analysis procedures. As previously mentioned, the methodological choice employed in this research is mono method quantitative; further discussion on the research strategy is provided in the following section.

3.5 Survey—Research Strategy

There are several types of 'research strategy' including experiment, survey, case study, action research, grounded theory, ethnography, and archival research. Some of these belong to the deductive approach, while others belong to the inductive approach. Saunders et al. (2019) state that a researcher's 'choice of research strategy will be guided by research question(s) and objectives, the extent of existing knowledge, the amount of time and other resources available, as well as the philosophical underpinnings' (p. 141). Saunders et el.'s (2019) advice was taken into account in the current research and led the researcher to decide that ‘survey strategy’ was the most appropriate data collection method to apply on this research topic.

The survey strategy, based on the research onion, is associated with the deductive approach, and tends to be used for either exploratory or descriptive research (Saunders et al., 2019). This method allows a researcher to observe and measure naturally occurring relationships between two or more variables; however, these variables should not be intentionally manipulated or interfered with by a researcher (Dempster & Hanna, 2015). The approach is most frequently used to answer questions such as who, what, where, how much and how many. The survey strategy is perceived as comparatively easy to explain and to understand, as well as authoritative by people in general. Dempster and Hanna (2015) advise that use of a survey strategy can enable collection of a large amount of data from a sizable population in a highly economical way and can be informative about a certain percentage of the population’s thinking or behaviour. If proper planning is employed to gather this type of data from a large sample size, this method tends to lead to high external validity as the researcher can generalise the findings from their study to the targeted population.

3.6 Cross-sectional Survey Design—Research Time Horizon

Another layer of the research onion that a researcher should take into consideration before proceeding to collect data is the ‘time horizon’. According to Saunders et al. (2019), the research strategy or choice of method influences time horizons in the research design. Dempster and Hanna (2015) categorise survey design into three groups in relation to time horizons: cross-sectional survey designs; longitudinal survey designs; and successive independent sample designs. Choice of survey design depends on whether data will be collected at a single time point, multiple time points or a mix of both. After thoroughly examining the research topic and questions, the time horizon selected for this research was ‘cross-sectional’.

A cross-sectional research design enables study of a particular phenomenon (or phenomena) at one point in time (Saunders et al., 2019). A researcher who adopts this time horizon seeks to identify the incidence of a phenomenon. For example, this research study aims to identify cognitive flexibility and coping strategies that influence stress levels in groups of airline pilots, student pilots and students who enter an aviation program. A cross-sectional survey is designed to collect data once from each individual at one point in time (Dempster & Hanna, 2015).

Dempster and Hanna (2015) suggest that a cross-sectional survey design can be used for two reasons: 1) to examine the relationships between at least two variables, and 2) to establish the prevalence of psychological variables, such as beliefs and attitudes, or mood states. Furthermore, Dempster and Hanna (2015, pp. 49–50) assert that this type of research design has some practical advantages, including:

- inexpensive resources required during the data collection process
- involving less time to collect data compared with other survey methods
- study flexibility as many variables can be measured within a study, so complex relationships can be examined
- consideration of participant availability to collect data at one time only.

Accordingly, the researcher in the present study proceeded through the process of research design from the methodological choice (mono method quantitative) and research strategy (survey) to the research time horizon (cross-sectional survey design) as depicted in Figure 3.1. However, before approaching the research time horizon, the first consideration in research planning is what the topic is about and what the research question aims to identify. This question led the researcher to ponder the research methodology most suitable to answer this question and achieve the best result within the time allowed for this research project. An addition step that the researcher had to take in the research planning was to consider how to conduct research in the extremely unusual or even unprecedented time during a global pandemic. Data collection methods that require some human interaction—for instance, experimental group, case study or grounded theory—were not viable during extensive periods of lockdowns. The research plan accounted for these highly unusual restrictions to the research. Utilising mono method quantitative cross-sectional survey as a data collection method offered various advantages including;

- the researcher had more control over the research process within time constraints

- the data could be gathered from a large sample in the shortest time
- the sample population could be used to generate findings that represent the whole targeted population, which is pilots and aviation students
- the collected data could be used to suggest possible reasons for any relationships identified between variables, such as those between stress, cognitive flexibility, and active coping strategies, as per the aims of this research study.

As the survey strategy allowed for collection of quantitative data from a large sample size, the researcher practised quantitative data analysis using descriptive and inferential statistics through the Statistical Package for the Social Sciences (SPSS). The data analysis methods employed are discussed further in Chapters 4 and 5. However, before proceeding to collecting and analysing data, which is the core of the research onion, a few more concepts had to be validated and taken into consideration when designing and planning the research. These concepts are reliability and validity considerations, sampling methods and survey methods.

3.7 Reliability and Validity Considerations

Dempster and Hanna (2015) and Saunders et al. (2019) stress that when conducting or evaluating any research study, a researcher must ensure that they evaluate both the reliability and validity of the study itself, as well as individual tests. Study 'validity' ensures that 'the extent of findings and conclusions of a piece of research are both accurate and trustworthy' (Dempster & Hanna, 2015, p. 21) whereas study 'reliability' refers to 'the extent to which the data collection techniques or analysis procedures will yield consistent findings' (Saunders et al., 2009, p. 156). Therefore, reliability exists when a test measures the same thing more than once and results in the same outcomes, whereas validity is shown when the test measures what is needed to be measured (Salkind, 2012). A review of the research design literature identified multiple considerations of which the researcher must be aware when conducting and designing research using questionnaires or tests.

When choosing a survey study as the preferred method to answer a research question, Dempster and Hanna (2015) emphasise that a researcher must verify the extent to which their study can be generalised from the findings, referred to as 'external validity'. The two external validity dimensions are population validity and ecological validity (Dempster & Hanna, 2015). Population validity is concerned with whether the results or findings from participants of the study can be generalised to the wider population of interest. Ecological validity relates to whether results from the study setting can be generalised to everyday life. In the current research study, the researcher considered these two validity dimensions and collected data from representative samples that may allow generalisation to the wider population (the data collection procedures are explained in Sections 4.2.4 and 5.2.4). Furthermore, the researcher collected data in a non-artificial way, which means they ensured the least interruption possible during the data collection process, as Dempster and Hanna (2015) also suggest that 'the more real-life data-collection procedures, the more ecological validity the study has' (p. 59). For example, when collecting data from students, the researcher did not interrupt or rush them to complete the survey. The survey questions and links were given only to students willing to take part in the survey.

Dempster and Hanna (2015) suggest that to collect data using questionnaires and psychometric tests, a researcher can use an existing questionnaire but only if it shows evidence of reliability and validity. Alternatively, the researcher can develop their own questionnaire if they cannot find an existing one that meets the needs of their study. However, the newly designed questionnaire must go through pilot testing to identify potential problems to be resolved and addressed in advance and seek feedback on how the questionnaire might be improved. To decide whether this research would be best conducted using existing questionnaires, or whether new questionnaires should be developed, the researcher reviewed various questionnaires relating to stress, cognitive flexibility and coping strategies, to determine whether any were suitable for this research study.

3.7.1 Assessing Test Validity and Reliability

Dempster and Hanna (2015) suggest that assessment of reliability in a survey study can be achieved by focusing on the reliability and validity of the tests, measures or questionnaires used to collect data. They identify that a test can be considered reliable if it is self-consistent in measuring the same thing in all parts of the test and if the same participant achieves the same score when completing the test on multiple occasions. Likewise, a test is considered valid if it measures what it claims to measure.

Reliability and validity cannot be demonstrated in absolute terms; instead, a researcher must gather reliability and validity evidence from the time of an existing questionnaire was published to examine whether its reliability and validity are convincing (Dempster & Hanna, 2015). The types of test validity that can be taken into consideration include 'face, construct, content, and criterion' validity, as discussed in the next subsection. In the current case, the evidence indicated that it was appropriate to focus on 'face' and 'construct' validation as reported in previous research reports. The researcher also assessed test reliability by searching for test–retest reliability and internal consistency. This information can be found in the questionnaire manual or the methods sections of the published research report. The following clarifications elected to use assessments to identify appropriate questionnaires for this study.

3.7.1.1 Validity Assessments

Face validity is an assessment based on the first glance when considering whether a questionnaire measures what it is specified to measure. For example, if a researcher aims to measure stress levels, the test items should be related to events that represent stressors, rather than including questions about a person's personality traits. However, Dempster and Hanna (2015) suggest that the researcher does not rely on face validity alone because there is no guarantee that questions are valid just because they are measuring a particular construct. Thus, research should gather additional evidence from another type of validity to ensure that a questionnaire is valid. Face validity initially helps to examine whether questionnaires contain questions suitable for participants in a planned study. To ensure that the questions meet face validity criteria, the researcher in the current study reviewed multiple questionnaires that inquired about stress, cognitive flexibility, and coping strategies; the selected questionnaires were considered to have the most appropriate questions for this research.

Construct validity assesses whether a questionnaire is accurately measuring what it intends to measure. For this study, the researcher gathered the relevant evidence by searching for convergent validity of the questionnaires and their factor structure based on the literature review, to be convinced that the test had construct validity.

Convergent validity is examined by comparing the test with another test that has the same or similar constructs to observe if they are highly correlated. For example, the *Cognitive Flexibility Inventory* (CFI) should have a high correlation with the *Cognitive Flexibility Scale* (CFS) (or other scales that measure one's ability to be cognitively flexible) as these two scales intend to measure similar constructs. Evidence of convergent validity is presented in the form of correlation coefficients. The closer the value to 1, the stronger the evidence for validity.

Structural validity can be found in the form of factor analysis, which is a statistical method used to determine which items on scales are related and which are not. A valid questionnaire or test should have subscales that belong to factors stated in the report that the questionnaire is published. A researcher can search for a statement in the research report to the effect that the factor structure was confirmed or supported by factor analysis.

3.7.1.2 Reliability Assessments

Internal consistency means that the items on the test are measuring the same thing. For example, cognitive flexibility questionnaires should include only items related to one's ability to be cognitively flexible rather than questions related to depression. Cronbach's alpha is the most frequently used statistic to identify the internal consistency of a test or questionnaire (Dempster & Hanna, 2015; Saunders et al., 2019). Cronbach's alpha has a maximum value of 1 and the higher the value the greater the internal consistency (Dempster & Hanna, 2015). In general, acceptable values are those greater than 0.70 and lower values may indicate unreliability of the test (Dempster & Hanna, 2015). However, very high values (above 0.95) can indicate that multiple items on a questionnaire are asking similar questions, which may mean that a trait is being assessed too narrowly.

Test–retest reliability can be assumed when a questionnaire or test gives consistent scores no matter how many times it is undertaken by the same individual, within a reasonable timeframe. However, Dempster and Hanna (2015) remark that test–retest reliability is only expected for trait constructs that theoretically demonstrate stability, and not with emotions that may change over time, such as mood or stress level. In the current study, only the CFI and CISS questionnaires were expected to exhibit high test–retest reliability because their questions seek consistency in an individual capability to be cognitively flexible and to cope with various situations. Test–retest reliability is normally presented in the form of a correlation coefficient. A highly reliable will have Cronbach's alpha higher than 0.80 (Dempster & Hanna, 2015).

Dempster and Hanna (2015) suggest that proving a test is fully reliable requires evidence of both internal consistency and test–retest reliability. Either of these alone is not sufficient to validate test reliability.

The researcher followed these validity and reliability guidelines by reviewing multiple pieces of literature concerned with stress levels, cognitive flexibility, and coping strategies. Four existing questionnaires were utilised in this research study: the *Job Stress Survey* (JSS), *Perceived Stress Scale* (PSS), CFI and CISS. The researcher gathered evidence regarding each questionnaire's validity and reliability to verify that the results of this research could be validated. Table 3.1 contains details related to internal consistency, test–retest reliability, convergent validity, and structural validity for each questionnaire. More detailed information related to these four questionnaires can be found in Sections 4.2.3 and 5.2.3.

Table 3.1

Recorded Reliability and Validity Information for the JSS, PSS-10, CFI, and CISS-48

Type of information	Reliability and validity information collected about questionnaires used for this study			
	JSS[1]	PSS-10[2]	CFI[3]	CISS-48[4]
Internal consistency	Cronbach's alpha = .95	Cronbach's alpha = .78	Cronbach's alpha = .91	Cronbach's alpha T [a] = .92 E [b] = .88 A [c] = .86
Test–retest reliability	Correlation = .48–.75	Correlation > .70	Correlation = .81	Correlation T & E > .8 A = .51–.60
Convergent validity (correlation with related measures)	Correlation = .64 (with MTSC [d])	Correlation = .67 (with GAD-7 [e])	Correlation = .75 (with CFS [f])	Correlation = .05–.49 depending on the factor (with WCQ [g])
Structural validity	Factor structure confirmed	Factor structure confirmed	Factor structure confirmed	Factor structure confirmed

[a] *Task-oriented coping strategies.* [b] *Emotion-oriented coping strategies.* [c] *Avoidance-oriented coping strategies.* [d] *Mykletun's Teacher Stress Check.* [e] *Generalised Anxiety Disorder-7.* [f] *Cognitive Flexibility Scale.* [g] *Ways of Coping Questionnaire.*

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[1] Information cited from *Job Stress Survey: Professional manual* (Spielberger & Vagg, 1999) and *Job Stress Survey (JSS)* (Statistics Solutions, 2022).

[2] Information cited from *Reliability and validity of the Perceived Stress Scale-10 in Hispanic Americans with English or Spanish language preference* (Baik et al., 2019) and *Review of the psychometric evidence of the Perceived Stress Scale* (Lee, 2012).

[3] Information cited from *The Cognitive Flexibility Inventory: Instrument development and estimates of reliability and validity* (Dennis & Vander Wal, 2010).

[4] Information cited from *Coping Inventory for Stressful Situations (CISS) manual* (Endler & Parker, 1999).

3.8 Non-probability Sampling Techniques—Sampling Method

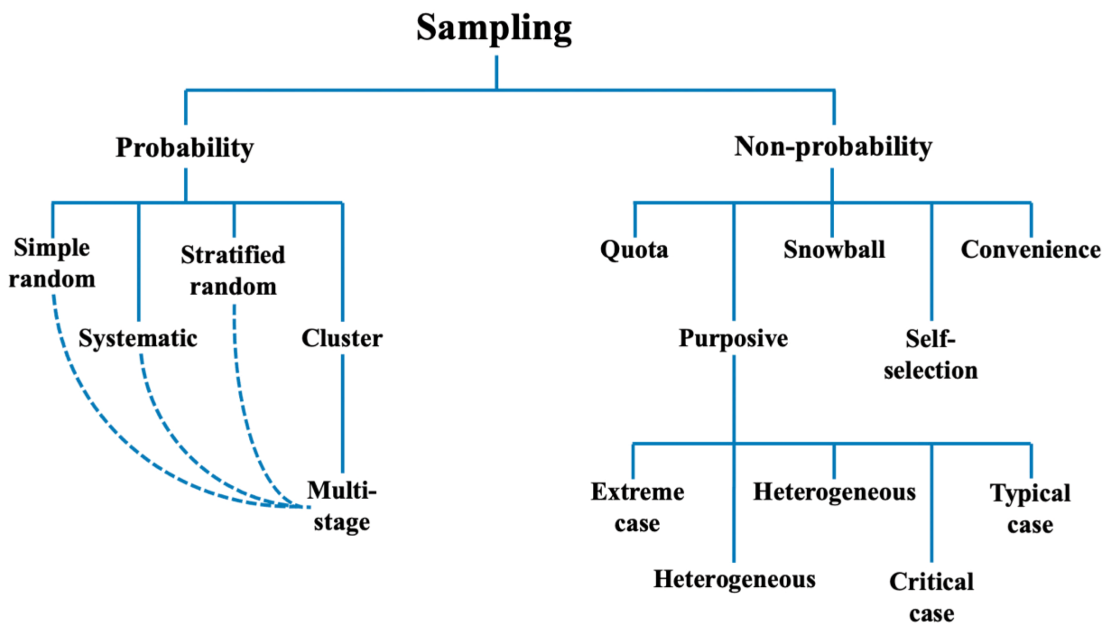
What is found from a study sample should represent the wider population (Dempster & Hanna, 2015; Salkind, 2012; Saunders et al., 2009). Thus, how a study sample is obtained should be one of the considerations when planning research to ensure that the results can be generalised to the wider population with the same characteristics.

According to Saunders et al. (2009), the choice of sampling technique depends on the research question. For some research questions, data can be collected from the entire population; for example, if the research focuses on an entire business or organisation. However, it would be impracticable to collect data from the entire population if the research question relates to cognitive flexibility in certain occupations such as commercial pilots, doctors, or nurses, as these groups constitute a large number of people from around the world. To address research questions focusing on different types of target population, two main types of sampling technique (Saunders et al., 2009), strategy (Salkind, 2012) and method (Dempster & Hanna, 2015) are suggested by these researchers to collect data: 1) 'probability-based sampling' and 2) 'non-probability-based sampling' (see Figure 3.3).

The difference between these two approaches is that probability-based sampling requires a complete list of all cases in the population from which a sample is drawn; known as the 'sampling frame'. However, this requirement is not applied to non-probability-based sampling (Salkind, 2012; Saunders et al., 2009). Saunders et al. (2009) suggest that some research projects might use different sampling techniques at different stages, while some projects use both probability and non-probability sampling. In reference to the research question of this research study, the researcher realised that it was not possible to collect data from the complete list of all commercial pilots or aviation students to measure their stress levels, cognitive flexibility levels or degree to which they adopted task-oriented coping strategies. Accordingly, non-probability-based sampling was incorporated into the data collection plan for this research.

Figure 3.3

Sampling Technique Diagram



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Saunders et al. (2009) explain that several non-probability techniques can be used, including quota, purposive, convenience, self-selection, and snowball sampling. A brief explanation is now provided for why two of these methods were not considered suitable for this research study, whereas the other three methods were.

Methods Not Selected for the Study

- **Quota sampling** was not selected because it is more suitable for interview surveys and the numbers in each subgroup need to be determined before recruiting people from the study population to reach a specific quota (Saunders et al., 2009). This method is not suitable because there are so few female pilots, thus, the pre-selected target number could not be determined whether the quota number can be fulfilled.
- **Purposive sampling** was not selected because it is more appropriate for small samples such as when using a case study or grounded theory strategy,

and where the researcher must use their judgement to select cases that will best enable the research question to be addressed (Saunders et al., 2009).

Methods Selected for the Study

- **Self-selection** was considered the most suitable method for this study as it allows individuals to express their desire to take part in the research. The researcher employed this method primarily because use of the chosen questionnaires was governed by agreements with companies that did not allow them to be in the public domain: Psychological Assessment Resources, Inc. (PAR) and Multi-Health Systems, Inc. (MHS). This meant that invitations to complete the survey were first sent to particular airlines and pilot association organisations, and if any pilots or aviation students agreed to complete the survey, a link to the survey was supplied.
- **Snowball sampling** was the second method employed in this study as it allows data to be collected via personal contact. This meant that the supervisory team could assist in identifying commercial pilots with whom they had a connection, and the primary researcher could then disseminate the survey link to specific people. Furthermore, the researcher was able to ask these pilots to share the link with their pilot acquaintances and colleagues to complete the survey.
- **Convenience sampling** was the last method employed in this study as it allows haphazard selection of samples that are easiest to obtain. This method was utilised for the group of aviation students because they had no experience of flying, thus any possible variations that could cause bias would not be effected by using this method.

The researcher considered many sampling techniques and examined the suitability and limitations of each before opting for self-selection, snowball, and convenience sampling to collect the data for this research study. Detailed information regarding the sample collected for this research is provided in Sections 4.2.2 and 5.2.2.

3.9 Online and Face-to-face–Survey Methods

According to Dempster and Hanna (2015), survey methods represent how a researcher plans to obtain data from participants at a single point in time. There are four modes of survey data collection: postal, face-to-face, telephone and online surveys. Each of these survey methods has advantages and disadvantages. Thus, proper planning is required before collecting data. The choice of survey method for use in this research study was based on the resources available and provided by the university, as well as data collection agreements with PAR and MHS that specified certain methods must be used with their survey questionnaires. The four main survey methods were reviewed, and online and face-to-face surveys selected to access participant responses in this research study.

3.9.1 Online Survey

Online survey can be applied to collect data electronically via a website, and participants can easily submit their responses online. The researcher simply sends the questionnaire to potential participants in the form of an electronic document. This is the most convenient method as participants can complete the survey electronically and the researcher can also store the data electronically instead of transferring it from paper format to a computer. Furthermore, online survey can be beneficial as the researcher can check the progress of participants in completing the survey. This survey method was applied to the groups of airline pilots and student pilots as it was the most convenience way to approach them.

This method was selected because the University of Southern Queensland (USQ) provides the LimeSurvey platform for staff and research students to use for research purposes. In addition, because of agreements with PAR and MHS, the researcher was allowed to send the survey link only to participants who agreed to complete the survey. The agreements did not allow the survey to be delivered on free accessible public space. Thus, the LimeSurvey platform was the most suitable online data collection channel as it limited entry and only participants who had the link could complete the survey.

3.9.1.1 Advantages of Online Survey

Dempster and Hanna (2015) identify multiple advantages of using online survey:

- In regard to cost and time effectiveness, a researcher can obtain samples from a large number of people from different geographical locations.
- Survey responses can be downloaded and analysed almost immediately.
- The survey can be completed whenever participants are ready to do so.
- Survey platforms (in this case, LimeSurvey) can be used to prompt participants to complete some items that they might have missed before clicking the submit button.
- Responses can be anonymous, and sensitive issues can be addressed more honestly.

3.9.1.2 Disadvantages of Online Survey

Online surveys also have some disadvantages:

- The researcher risks obtaining a biased sample as the researcher will not know whether the potential participants are in the targeted group.
- One participant might complete the survey many times, although this can be prevented on LimeSurvey, which accepts only one survey response from a given IP address. However, the survey can be resumed from the same IP address if the participant has not fully completed the survey.
- The researcher risks including participants that are not in the target group. This issue could be easily controlled in the current research study because participants were selected from a contact list held by the research supervisors and the researcher used snowballing sampling to access more participants. This ensured that all respondents were from the target population.
- The response rate can be difficult to determine; however, an effective function on LimeSurvey enabled the total number of participants to be determined and recorded even if some participants opened but did not finish the survey.

3.9.2 Face-to-face Survey

Face-to-face surveys can be used to collect data from multiple individuals within the target group at the same time (Dempster & Hanna, 2015). This method was utilised with the group of aviation students in this research to collect the same information as in the online survey with the exception that some demographic information collected differed from that for the group of airline pilots. With this strategy, a large sample can be accessed simultaneously, but the documents are in the form of a hard copy. Other advantages and disadvantages associated with this survey method are discussed in the following section.

3.9.2.1 Advantages of Face-to-face Survey

Dempster and Hanna (2015) advise that face-to-face data collection from either an individual or a group has some advantages in common:

- Participants can ask questions directly if they are concerned about any ambiguity or misunderstanding. In this research study, the researcher disseminated hard copies of questionnaires and allowed students to complete them in their own time and return the hard copy when they had finished. Students were able to ask questions when they returned the hard copy to the researcher.
- It is possible to include participants who may have difficulties completing a questionnaire, such as people with impaired vision or hearing.
- The researcher can directly engage with and motivate participants to complete the survey.

3.9.2.2 Disadvantages of Face-to-face Survey

Along with the multiple advantages of face-to-face survey, there are also potential disadvantages:

- Face-to-face surveys can be time consuming to collect because the researcher needs to wait around to receive the hard copy. In this study, the researcher collected data after students had finished their class, and the expected time to complete the survey was 15–20 minutes.

- Travelling may be required for this type of data collection, either by participants or the researcher, who needs to disseminate the information. In this study, the researcher arranged to travel to multiple flying schools so that data could be gathered from students from a range of flying schools.
- The data collected are not anonymous, which may affect the way participants answer questions. Dempster and Hanna (2015) state that this can create a *social desirability bias*, which means that participants answer questions in a way they believe that others would approve rather than the way they behave in everyday life. The researcher in this study expected that this problem could be overcome through the reliability and validity of the questionnaires themselves.

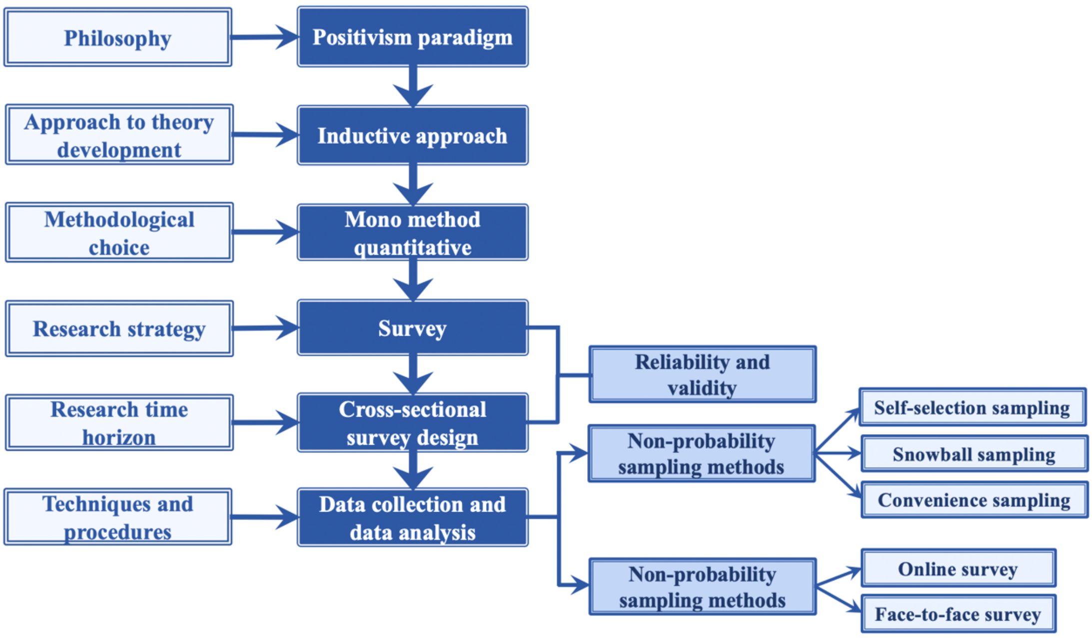
The survey method is a part of the survey design and should be thoroughly planned to ensure that a sufficient number of targeted participants can be accessed during the data collection process. During the data collection process in the current study there were challenges involved with the COVID situation. For example, airline pilots were facing severe challenges in their careers from the impacts of the pandemic that restricted the air travel, which causing pilot to start losing their jobs. This event occurred just a few weeks after the survey was disseminated, which made it more difficult to find potential participants from this group for study. It took around seven months to gain responses from airline pilots. However, with proper planning in regard to survey methods and heeding of lessons learnt when collecting data from the airline pilot group, data collection from aviation students was achieved within the expected timeframe.

3.10 Methodology Summary

This methodology chapter forms a ‘hinge’ between the literature review and the results chapters by elucidating various steps following the research onion model to create the most appropriate results, as shown in Figure 3.4. The discussion began with selection of the positivist paradigm and a detailed explanation of the philosophies behind it that have given rise to an appropriate inductive approach to theory development. The research planning process for this project involved the mono method quantitative approach as a methodological choice, enabling survey to be elected as a research strategy and cross-sectional survey design as a research time horizon. As part of the process of survey design, the researcher emphasised reliability and validity considerations as required when using survey questionnaires as a method for data collection. The survey design also included the non-probability sampling methods chosen for this research study, which involved self-selection, snowball, and convenience sampling methods. The research planning process concluded with survey methods, which involved online and face-to-face surveys to gather participant responses. The data collection and data analyses are described in the next chapters.

Figure 3.4

Methodology Summary



CHAPTER 4: STUDY 1—AIRLINE PILOTS

4.1 Purpose

The purpose of this study was to gain a better understanding of the correlation between stress, cognitive flexibility, task-oriented coping strategies, and individual resilience in the fast-paced safety-critical environment of aviation. The findings from this survey study were expected to add to the body of knowledge to better understand how two resilience factors (cognitive flexibility and task-oriented coping strategies) can influence pilots' stress levels when coping in their stressful working environment. The results of this initial study were anticipated to provide greater insight into correlations between these factors to inform a following study involving the group of aviation students.

4.2 Method

4.2.1 Design Overview

The primary purpose of this study was to gather data on airline pilots' stress levels, cognitive flexibility levels and preferences for diverse coping strategies (i.e., task, emotion, and avoidance) to examine whether the level of cognitive flexibility and the degree to which pilots adopt different coping strategies can influence their stress levels. The secondary purpose was to examine whether a particular coping strategy is positively or negatively correlated with cognitive flexibility among these airline pilots. Furthermore, the study aimed to identify whether demographic variables such as age, rank, flying experience and increased workload influence changes in these factors.

For the purposes of this study, the researcher adopted three questionnaires—the JSS (Spielberger & Vagg, 1999), CFI (Dennis & Vander Wal, 2009) and CISS (Endler & Parker, 1990, 1999)—developed as 'self-report' tools to measure resilience factors in response to stress. The JSS questionnaire assesses generic job-related stressor events; the CFI questionnaire measures the level of cognitive flexibility for individuals; and the CISS questionnaire measures one's preference for task, emotion or avoidance coping strategies. The survey also gathered information on nine demographic variables to provide an opportunity to compare these between groups of airline pilots differing in age or flying experience.

4.2.2 Participants

A total of 77 airline pilots completed the survey and their responses were used for the data analysis in this study. The majority of the pilots (*n* = 55, 71.4%) had a total flying experience of more than 5,000 hours, and none had 300 hours or less of flying experience (Table 4.1). The majority (*n* = 46, 59.7%) had average annual accumulated flying hours of 601–900 hours, followed by 301–600 hours (*n* = 23, 29.9%). The largest number of pilots (*n* = 35, 45.5%) had been flying more than 15 years, followed by 11–15 years (*n* = 19, 24.7%), 6–10 years (*n* = 12, 15.6%) and 5 years or less (*n* = 11, 14.3%). Most of the responding pilots were males (*n* = 72, 93.5%), and the rest were females (*n* = 5, 6.5%).

The demographic information also showed that the pilots' ages varied from more than 55 years old (*n* = 11, 14.3%), 46–55 years old (*n* = 17, 22.1%), 36–45 years old (*n* = 24, 31.2%), 26–35 years old (*n* = 21, 27.3%) and 25 years old or less (*n* = 4, 5.2%). There were 35 pilots in a captain position (45.5%) and 42 pilots in a co-pilot position (54.5%). Furthermore, most of the pilots flew short-haul flights[5] (*n* = 40, 51.9%), followed by long-haul[6] (*n* = 25, 32.5%) and then medium-haul flights[7] (*n* = 12, 15.6%). The highest number of pilots was engaged in domestic (*n* = 43, 55.8%) rather than international flying services (*n* = 34, 44.2%). Finally, the data also showed similar numbers of pilots flying wide-body[8] (*n* = 31, 40.3%), turboprop (*n* = 24, 31.2%) and narrow-body aircraft[9] (*n* = 22, 28.6%).

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[5] A short-haul flight is one of up to 3 hours in duration (Wilkerson et al., 2010).
[6] A long-haul flight runs for 6–12 hours (Wilkerson et al., 2010).
[7] A medium-haul flight is 3–6 hours (Wilkerson et al., 2010).
[8] A wide-body aircraft is a commercial airliner with two aisles (Loftin, 2021).
[9] A narrow-body aircraft is a commercial airliner with a single aisle (Loftin, 2021).

Table 4.1

Demographic Characteristics of Participating Airline Pilots

Demographic features	Frequency	%
(1) Total flying hours		
300 or less	0	0
301–2,000	9	11.7
2,001–5,000	13	16.9
More than 5,000	55	71.4
(2) Average annual accumulated flying hours		
300 or less	5	6.5
301–600	23	29.9
601–900	46	59.7
More than 900	3	3.9
(3) Number of years flying commercially		
5 years or less	11	14.3
6–10	12	15.6
11–15	19	24.7
More than 15	35	45.5
(4) Gender		
Male	72	93.5
Female	5	6.5
(5) Age (years)		
25 or less	4	5.2
26–35	21	27.3
36–45	24	31.2
46–55	17	22.1
More than 55	11	14.3
(6) Current rank		
Captain	35	45.5
Co-pilot	42	54.5
(7) Mostly fly short, medium, or long-haul flight?		
Short-haul (1–3 hours)	40	51.9
Medium-haul (3–6 hours)	12	15.6
Long-haul (6–12 hours)	25	32.5
(8) Mostly fly domestically or internationally?		
Domestic	43	55.8
International	34	44.2
(9) Type of aircraft currently flying		
Turboprop	24	31.2
Narrow-body jet	22	28.6
Wide-body jet	31	40.3

4.2.3 Materials

Before selecting the questionnaires for use in this research, the researcher thoroughly contemplated the research questions and objectives of the study. First, the researcher established a selection criterion for each questionnaire: they must seek information regarding to what level participants experience stress; the level of cognitive flexibility exhibited under stress; and reflections on what kind of coping strategies participants engage to be able to bounce back from the negative experience of stress. Second, the researcher reviewed a range of questionnaires including the JSS, CFI and CISS to select those that met the study criteria. Finally, the supervisory team assisted in reviewing the selected questionnaires and confirmed with the researcher that these questionnaires are widely used for research purposes.

The questionnaires were delivered on the LimeSurvey platform with four sections under clear headings: (1) demographic information; (2) JSS questionnaire; (3) CFI questionnaire; and (4) CISS questionnaire.

4.2.3.1 Demographic Information

This section was comprised of nine questions (as per Table 4.1) that aimed to collect the following information: (1) total flying hours, (2) average annual accumulated flying hours, (3) number of years flying commercially, (4) gender, (5) age, (6) current rank, (7) flying range, (8) flying domestic flights or international flights and (9) aircraft type.

4.2.3.2 Job Stress Survey (JSS)

The JSS was developed by Spielberger and Vagg (1999) to assess generic sources of occupational stress encountered by men and women in a variety of work settings including educational, industrial, military and business settings (Spielberger & Reheiser, 1994; Turnage & Spielberger, 1991) that could cause lack of productivity, absenteeism, worker turnover and stress-related health problems. The JSS 30-item was designed as a self-report questionnaire to evaluate the degree of agreement or disagreement with 30 statements describing sources of work-related stress that often result in psychological strain. The JSS also includes questions about the severity of specific stressor events as perceived by an employee, and how often each stressor had been experienced during the previous six months. The JSS has been used for research in occupations such as psychotherapy (Eunha, 2007), policing (Berg et al., 2006; Haisch & Meyers, 2004) and the medical professions (Brgard et al., 2012; Peltzer et al., 2003).

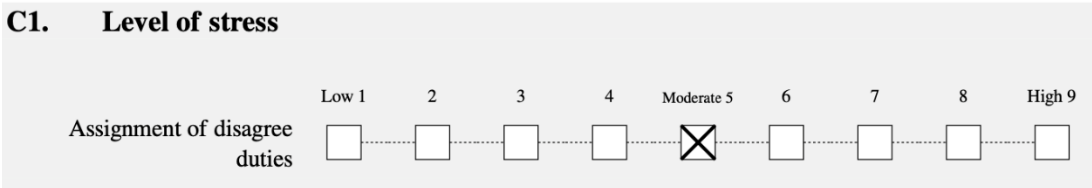
Spielberger and Vagg (1999) constructed the JSS into three main scales:

1. The Job Stress Index (JS-X) scale provides an estimate of the overall level of occupational stress experienced by an employee in their work setting. It combines the severity and frequency ratings from all 30 JSS items.
2. The Job Stress Severity (JS-S) scale indicates the employee's average rating of perceived severity for the 30 JSS stressor events. These scores are based on the employee's comparison of each of the 29 severity items (2A–30A) with the standard stressor (Item 1A), which is assigned a constant mid-scale value of 5.
3. The Job Stress Frequency (JS-F) scale represents the average *frequency of occurrence* of the 30 JSS stressor events during the previous six months.

In responding to the JSS items, participants first rate the perceived severity of each stressor event in comparison with a standard stressor (i.e. 1A–'Assignment of disagreeable duties'), using a nine-point Likert scale ranging from 1 = *low stress* to 9 = *high stress* with a midpoint scale value of 5 = *moderate* (Figure 4.1). After rating the perceived severity of the remaining 29 JSS stressor events, employees use a scale of 0–9+ days (Figure 4.2) to report how often each stressor occurred during the previous six months. Index scores for each JSS item provide estimates of the amount of occupational stress experienced by employees in areas evaluated by the JSS. Some examples of JSS questions are provided in Figure 4.3. However, the full list of JSS questions cannot be included in this thesis because of the licence agreement with PAR.

Figure 4.1

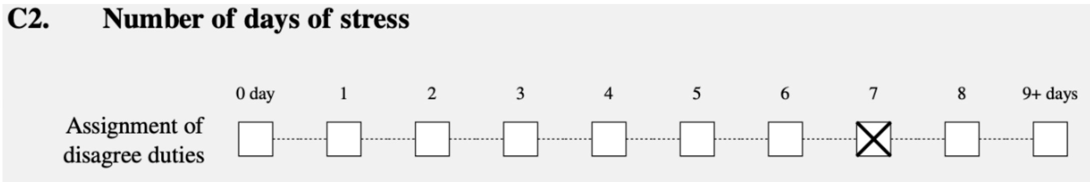
Example of a Standard Item to Measure the Severity of a Stressor Event



Note. Adapted from ‘Job Stress Survey Professional Manual: Form HS’, by C. Spielberger and P. Vagg, 1999, Florida: Psychological Assessment Resources, Inc. (PAR). Copyright 1999 by PAR. Adapted with permission.

Figure 4.2

Example of JSS Scale to Measure the Frequency of a Stressor Event



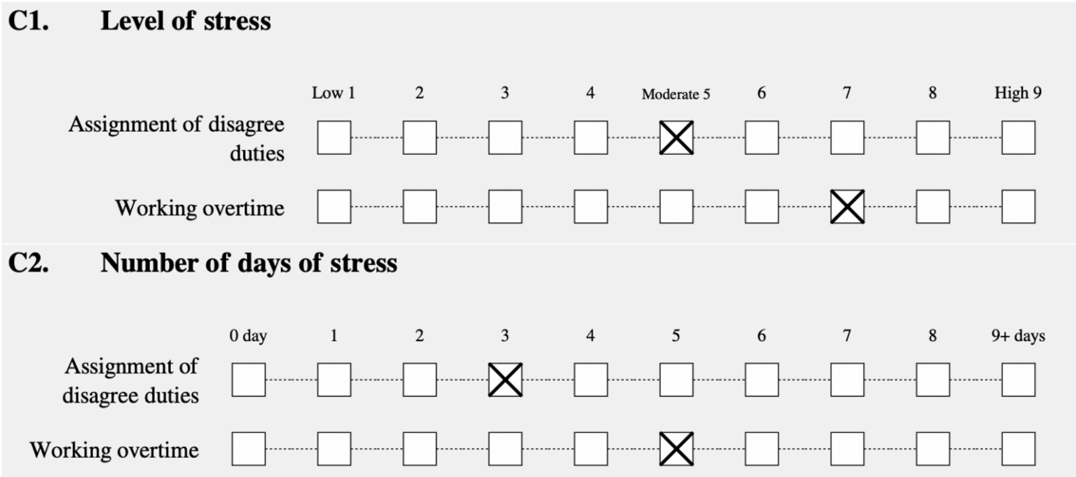
Note. Adapted from ‘Job Stress Survey Professional Manual: Form HS’, by C. Spielberger and P. Vagg, 1999, Florida: Psychological Assessment Resources, Inc. (PAR). Copyright 1999 by PAR Inc. Adapted with permission.

4.2.3.2.1 JSS scoring process

To compute the JS-X score, each item from the severity rating is multiplied by its frequency rating, followed by summing these scores and dividing by 30 as there are 30 questions. For example, if a participant rates their level of stress for question 2A (Working overtime) as 7, and then rates the number of days of stress for question 2B (Working overtime) as 5, the JS-X raw score becomes 35 (Figure 4.3). This process is repeated for the remaining 29 JSS questions. The minimum possible JS-X score is zero, for a respondent who reports experiencing none of the JSS stressors events in the preceding six months (i.e., 30 × 0). Given the constant score of ‘5’ assigned to the standard severity stressor (A1), a maximum rating of 9 for the 29 remaining severity items (2A–30A) and scores of 9+ for each of the 30 frequency items (1B–30B), the highest possible JS-X raw score is 79.8: [(5 × 9) + (9 × 9 × 29)] ÷ 30.

Figure 4.3

Example Items for JSS Score Calculation



Note. Adapted from 'Job Stress Survey Professional Manual: Form HS', by C. Spielberger and P. Vagg, 1999, Florida': Psychological Assessment Resources, Inc. (PAR). Copyright 1999 by PAR Inc. Adapted with permission.

4.2.3.2.2 Interpretation of JSS scoring

Spielberger and Vagg (1999) suggest that interpreting responses when JSS scoring requires the researcher to scale scores with appropriate normative data, and knowledge of the normative samples used in the JSS standardisation. The normative data for the JSS was obtained by Spielberger and Vagg (1999) by administering the inventory to a heterogeneous sample of 2,173 adults (1,218 males, 955 females) employed in business, industry, university, and military settings.

Spielberger and Vagg (1999) evaluated differences in JSS scores from the normative samples by grouping employees into higher and lower occupational levels as shown in Table 4.2. Employees working at a higher occupational level (*n* = 983) included managers (executives, university administrators, department heads) and professionals (engineers, accountants, university faculty). Employees working at the lower occupational level (*n* = 808) consisted of skilled technicians, and clerical and maintenance personnel. The senior military personnel sample (*n* = 382) was not used in the evaluation of the relationship between job stress and occupational level, but was included to demonstrate that the JSS can be used with a unique group of highly successful leaders with demanding administrative and managerial responsibilities (Spielberger & Vagg, 1999).

Table 4.2

JSS Means, Standard Deviations and Alpha Coefficients for the JS-X, JS-S and JS-F Scale Scores for Females and Males in Higher and Lower Occupation Normative Groups

Job stress scale	Managerial/professional			Clerical/skilled maintenance			Senior military		
	Females	Males	Total	Females	Males	Total	Females	Males	Total
JS Index									
JS-X *M*	20.37	20.09	20.19	19.76	19.36	19.65	22.13	20.72	20.81
SD	10.37	9.90	10.06	12.19	12.97	12.40	8.25	7.99	8.00
n	340	643	983	590	217	807	24	358	382
α	.88	.87	.87	.91	.92	.91	.79	.84	.84
JS Severity									
JS-S *M*	4.95	4.91	4.92	4.87	4.74	4.85	5.21	4.96	4.98
SD	1.10	1.10	1.03	1.33	1.33	1.33	.77	.69	.70
n	340	340	983	591	217	808	24	358	382
α	.91	.91	.89	.93	.93	.93	.77	.83	.82
JS Frequency									
JS-F *M*	3.68	3.70	3.69	3.40	3.32	3.38	4.31	4.32	4.32
SD	1.66	1.62	1.63	1.79	1.90	1.81	1.41	1.40	1.40
n	340	643	983	591	217	808	24	358	382
α	.89	.89	.89	.91	.92	.91	.85	.86	.86

Note. Adapted with permission from 'Job Stress Survey Professional Manual' (p. 16), by C. Spielberger and P. Vagg, 1999, Psychological Assessment Resources (PAR). Copyright 1999 by PAR Inc.

To examine whether the airline pilot occupation is more comparable with the higher or lower occupation level normative group, the researcher reviewed the *International Standard Classification of Occupations* to gather more detailed information. The International Labour Office (ILO, 2012) classifies 'Aircraft Pilots and Related Associate Professionals' under the 'Technicians and Associate Professionals' group, which requires a skill level of at least 3 (out of 4). The ILO further describes that 'Occupations at Skill Level 3 typically involve the performance of complex technical and practical tasks that require an extensive body of factual, technical and procedural knowledge in a specialised field', which is a more complex duty than skill level 1 and 2 (ILO, 2012 p. 13). This information was used to determine that the airline pilot occupation should be considered a higher occupation level. Therefore, this study adopted the *T*-score conversion for the higher occupation group as a base reference against which to compare the JSS scores for the group of airline pilots as part of the explanation of the descriptive statistics in this study.

4.2.3.3 Cognitive Flexibility Inventory (CFI)

The CFI questionnaire was developed by Dennis and Vander Wal (2009) as a 20-item brief self-report that measures the cognitive flexibility necessary to replace maladaptive thoughts with more balanced and adaptive thinking when encountering stressful life events. It was designed to distinguish the level of cognitive flexibility/rigidity possessed by an individual, to measure two aspects of cognitive flexibility: (a) the tendency to perceive difficult situations as controllable (as reflected in control scale questions); and (b) the ability to generate multiple alternative solutions to difficult situations (as reflected in alternative scale questions). Dennis and Vander (2009, p. 243) also suggest that:

> Individuals possessing cognitive flexibility in these areas may be more likely to react adaptively in response to encountering difficult life experiences, while cognitively inflexible individuals who lack these skills may be more susceptible to experiencing pathological reactions in response to these experiences.

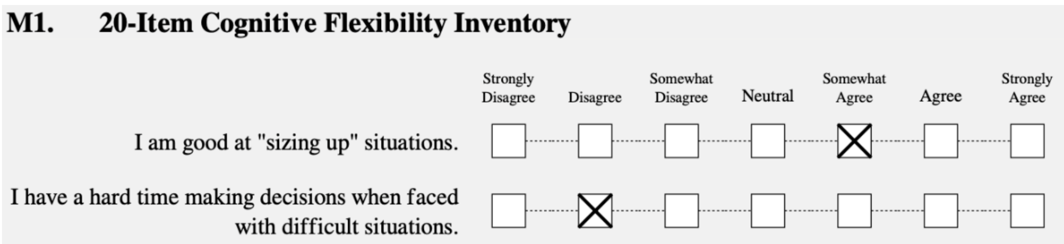
The CFI has been reassessed for its reliability and validity and translated into many languages including Chinese (Wang et al., 2016), Iranian (Shareh et al., 2014) and Turkish (Sapmaz & Dogan, 2013). The CFI has also been adopted in studies related to stress and coping; for example, in nurses (Kruczek et al., 2020) and firefighters (Borzyszkowska & Basińska, 2020).

4.2.3.3.1 CFI scoring process

The 20-item CFI was designed with a seven-point Likert scale test as a response format option ranging from 1 *strongly disagree* to 7 *strongly agree* (Figure 4.4) to gather statements dealing with beliefs and feelings about behaviours, with which respondents can indicate agreement or disagreement (the full list of questions is presented in Appendix 1). Dennis and Vander Wal (2009) advise that before summing numerical response values and obtaining a CFI total score, some items require specific procedures to reverse scoring. Reverse scoring is a process used to reverse numerical scoring scales that run in the opposite direction before calculating the total score. A reverse score is used for some CFI items because the questionnaire was designed to include elements of positively-keyed[10] and negatively-keyed[11] items and these need to be made consistent in terms of what is implied by an agree or disagree score on the same seven-point scale. Therefore, before summing scores, a researcher reverses items 2, 4, 7, 9, 11 and 17 as per the CFI scoring instructions, ensuring that the scores are correctly counted. As each question has a minimum score of 1 and maximum of 7 points, the total CFI score can range from 20 to 140.

Figure 4.4

CFI Sample Questions


M1. 20-Item Cognitive Flexibility Inventory

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
I am good at "sizing up" situations.	☐	☐	☐	☐	☒	☐	☐
I have a hard time making decisions when faced with difficult situations.	☐	☒	☐	☐	☐	☐	☐

Note. Adapted from 'Cognitive Flexibility Inventory: Instrument Development and Estimates of Reliability and Validity', by J. Dennis and J. Vander Wal, 2010, *Cognitive Therapy and Research 34*, pp. 251–252 (https://doi.org/10.1007/s10608-009-9276-4). Copyright 2010 by Springer Nature Sharedlt.

4.2.3.3.2 Interpretation of CFI scoring

Dennis and Vander Wal (2009) instruct that higher CFI scores are intended indicate greater cognitive flexibility, which is predicted to be associated with greater cognitive adaptability (the ability to switch cognitive sets to adapt to changing

[10] Positively keyed items are those phrased so that agreement with the item represents a relatively high level of the attribute being measured (Batangas State University, n.d.).

[11] Negatively keyed items are those phrased so that agreement with the item represents a relatively low level of the attribute being measured (Batangas State University, n.d.).

environmental stimuli) when encountering stressful situations. Lower scores are intended to be indicative of greater cognitive rigidity, which is predicted to be associated with less cognitive adaptability when encountering stressful situations. Unadvisedly, Dennis and Vander Wal do not recommend a standard cut-off score.

4.2.3.4 Coping Inventory for Stressful Situations (CISS)

The CISS questionnaire was developed by Endler and Parker (1990, 1999) as a 48-item self-report, of which 16 items assess task-oriented (T) coping styles, 16 assess emotion-oriented (E) coping styles and 16 assess avoidance-oriented (A) coping styles to measure an individual's preferred coping styles when encountering stressful situations and negative events. There are both adult and adolescent forms. The adult form was used for this study.

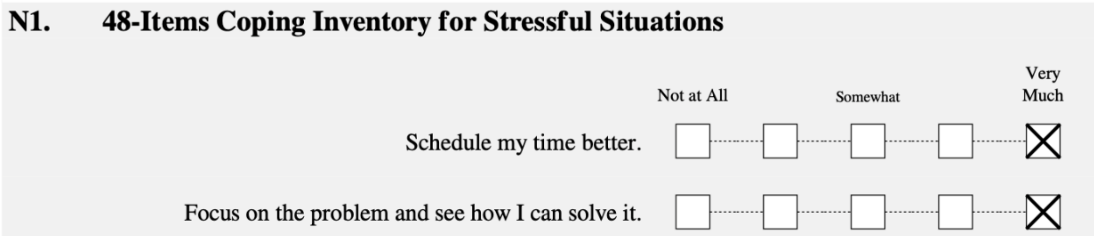
Endler and Parker (1990, 1999) assert that the CISS is appropriate for use with a wide range of respondents as it is easily administered to college students, adults with a wide range of educational backgrounds and a range of occupational groups including pilots (Szymanik & Terelak, 2015), medical students (Tanaka et al., 2009) and aircraft crew members (Terelak & Szewczyk, 2013). The normative data were collected by Endler and Parker from various subgroups (e.g., teachers, inmates of correctional services, airline pilots). Therefore, this set of data was employed as a standard measure against which to compare data from other study groups.

4.2.3.4.1 CISS scoring process

The CISS was designed as a five-point frequency scale for respondents to rate each item ranging from 1 '*Not at all*' to 5 '*Very much*' (Figure 4.5). The score indicates the extent to which the respondents engage in each activity when in difficult, stressful, or upsetting situations. The potential range for each of the 16-item coping scales (i.e., T, E and A) is 16–80. To calculate the total CISS score for each dimension, the score for the task-oriented (items 1, 2, 6, 10, 15, 21, 24, 26, 27, 36, 39, 41, 42, 43, 46 & 47) the emotion-oriented (items 5, 7, 8, 13, 14, 16, 17, 19, 22, 25, 28, 30, 33, 34, 38 & 45) and the avoidance-oriented scales (items 3, 4, 9, 11, 12, 18, 20, 23, 29, 31, 32, 35, 37, 40, 44 & 48) are summed. Some CISS items are mentioned in this chapter but the full list of CISS questions cannot be included because of the licence agreement with MHS.

Figure 4.5

CISS Sample Questions


N1. 48-Items Coping Inventory for Stressful Situations

Not at All — Somewhat — Very Much

Schedule my time better.

Focus on the problem and see how I can solve it.

Note. Adapted from 'Coping Inventory for Stressful Situations Manual', by N. Endler and J. Parker, 1990, 1999, Ontario: Multi-Health Systems Inc. (MHS). Copyright 1999 by MHS Inc. Adapted with permission.

4.2.3.4.2 Interpretation of CISS scoring

Endler and Parker (1990, 1999) explain that the higher the test score on any of the three subscales (T, E and A), the greater the degree of coping activity for the person on the corresponding coping dimension. For example, if a pilot scores high on the task- or avoidance-oriented coping dimension, this indicates that the pilot utilises task- or avoidance-oriented coping strategies when encountering stressful events. Additionally, it should be emphasised that all CISS emotion-oriented coping dimensions are measured using negative questions. Thus, a positive sign for resilience would be that an airline pilot scores low in regard to coping strategies, as high emotion-oriented coping leads to more engagement in avoidance coping while low emotion-oriented coping leads to more engagement in task-oriented coping.

Table 4.3

A Sample of CISS Profile Forms for the Three Coping Strategies for T*-score Conversion*

		Task		Emotion		Avoidance	
%ile	***T***	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
99	75	>82	>79	>67	>70	>61	>69
99	74	82	79	67	70	61	69
99	73	81		66	69	60	68
99	72	80	78	65	67-68	59	67
99	71	79	77	63-64	66	58	66
98	70	78	76	62	65	57	65
97	69	77	75	61	64	56	64
96	68	76	74	60	63	55	63
96	67	75	73	59	62	54	62
95	66	74		58	61	53	61
93	65	73	72	56-57	60		60
92	64	72	71	55	58-59	52	59
90	63	71	70	54	57	51	58
89	62		69	53	56	50	57
86	61	70	68	52	55	49	56
84	60	69	67	51	54	48	55
82	59	68		50	53	47	54
79	58	67	66	48-49	52	46	53
76	57	66	65	47	50-51	45	52
73	56	65	64	46	49	44	51
69	55	64	63	45	48	43	50
66	54	63	62	44	47	42	49
62	53	62	61	43	46	41	48
58	52	61	60	41-42	45	40	47
54	51	60		40	44	39	46
50	50	59	59	39	42-43	38	45
46	49	58	58	38	41	37	44
42	48	57	57	37	40	36	43
38	47	56	56	36	39	35	42
35	46	55	55	35	38	34	41
31	45	54	54	33-34	37	33	40
27	44	53		32	36	32	39
24	43	52	53	31	35	31	38
21	42	51	52	30	33-34	30	37
18	41	50	51	29	32		35-36
16	40	49	50	28	31	29	34
14	39	48	49	26-27	30	28	33
12	38	47	48	25	29	27	32
10	37	46	47	24	28	26	31
8	36	45		23	27	25	30
7	35	44	46	22	25-26	24	29
6	34	43	45	21	24	23	28
5	33	42	44	20	23	22	27
4	32	41	43	18-19	22	21	26
3	31	40	42	17	21	20	25
2	30	39	41	16	20	19	24
1	29	38			19	18	23
1	28	37	40		18	17	22
1	27	36	39		16-17	16	21
1	26	35	38				20
1	25	<35	<38				<20
%ile	***T***	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**

Note. Adapted with permission from 'Coping Inventory for Stressful Situations Manual', by N. Endler and J. Parker, 1990, 1999, Ontario: Multi-Health Systems (MHS). Copyright 1999 by MHS Inc.

The interpretation of the total CISS score for each coping dimension requires profile forms for a score comparison (as shown in Table 4.3). Profile forms are reported as *T*-scores, which are used as standardised scores such that the three scales have the same mean and standard deviation. Endler and Parker (1990, 1999) advise that this comparison is not possible if the scale scores are not transformed since there are different numbers of items comprising each scale; hence the range of each scale before transformation is different. This process allows the score of one scale to be directly comparable with another scale. Therefore, linear *T*-scores are used with the CISS, and have a mean of 50 and standard deviation of 10.

T-scores can be interpreted using the guidelines provided in Table 4.4. Raw scores that fall into the *T*-score range on the profile forms apply for these numbers as a standard cut-off point for the data interpretations in this study. For example, this study uses a *T*-score of 61–65 as a cut-off point for the above average range on each coping dimension (Endler & Parker, 1990, 1999). This means that a male who obtains a task-oriented coping raw score of 70 or above, an emotion-oriented coping raw score of 52 or above, or an avoidance-oriented coping raw score of 49 or above is considered to use these coping strategies more than the average person. The equivalent cut-off *T*-scores for the female group were 68 or above, 55 or above and 56 or above, respectively.

Table 4.4

CISS Interpretive Guidelines for T-scores

T-score	Guideline
Above 70	Very much above average
66–70	Much above average
61–65	Above average
56–60	Slightly above average
45–55	Average
40–44	Slightly below average
35–39	Below average
30–34	Much below average
Below 30	Very much below average

Note. Adapted with permission from ‘Coping Inventory for Stressful Situations Manual’, by N. Endler and J. Parker,1990, 1999, Ontario: Multi-Health Systems (MHS). Copyright 1999 by MHS Inc.

4.2.4 Procedure

The LimeSurvey platform was selected to host the survey questionnaires as it was provided by the USQ to all its staff, students, and researchers at no cost. LimeSurvey was designed as an online statistical survey tool for research institutes, universities, and other educational institutions. A user can develop and publish online surveys, collect responses, create statistics and export resulting data to other applications (LimeSurvey, n.d.). Furthermore, the LimeSurvey platform does not limit the number of users, participant responses or survey questions that can be added, which provides full flexibility in an experimental design for research purposes.

To use the JSS and CISS questionnaires for research on an open-source online platform, the researcher was required to acquire permission from PAR to use the JSS questionnaire and from MHS to use the CISS questionnaire (Licence Agreements and Permission to Copy are attached in Appendix 2 & 3). Having granted permission to use these surveys, the PAR and MHS sent the researcher the JSS and CISS manuals outlining procedures and guidelines for the interpretation of scoring along with the full survey questions. The full questionnaires were placed on the LimeSurvey platform ready to submit for ethical review to gain approval for data collection.

After ethics approval was granted (Human Research Ethics [HRE] ID: H19REA301 as provided in Appendix 4), invitations to participate in this study were sent to various airline management personnel in Australia via e-mail, asking them to disseminate the request to complete the survey to their pilots. Participation was also invited through personal contact by approaching airline pilots directly. As the company contracts controlled the number of participants who could access the survey and it was not to be placed in the public domain, only participants who agreed to complete the survey were provided with the survey link to JSS and CISS surveys. Therefore, any participants who were interested in participating in this study were asked to send a direct e-mail to the researcher requesting the survey link, and the researcher then sent the link to that individual to complete the survey. No remuneration was offered as an incentive to participate in the survey. The survey was open from 2 February to 30 November 2020. This timing was unfortunate because the COVID pandemic at the time was having severe impacts on the aviation industry including the group of potential airline pilots. Many flights were cancelled because of border closures between countries and pilots were encountering many unexpected changes. The researcher was informed by many companies and pilots that they were unable to participate in the survey during this period as they were required to focus on more immediate and higher-priority tasks.

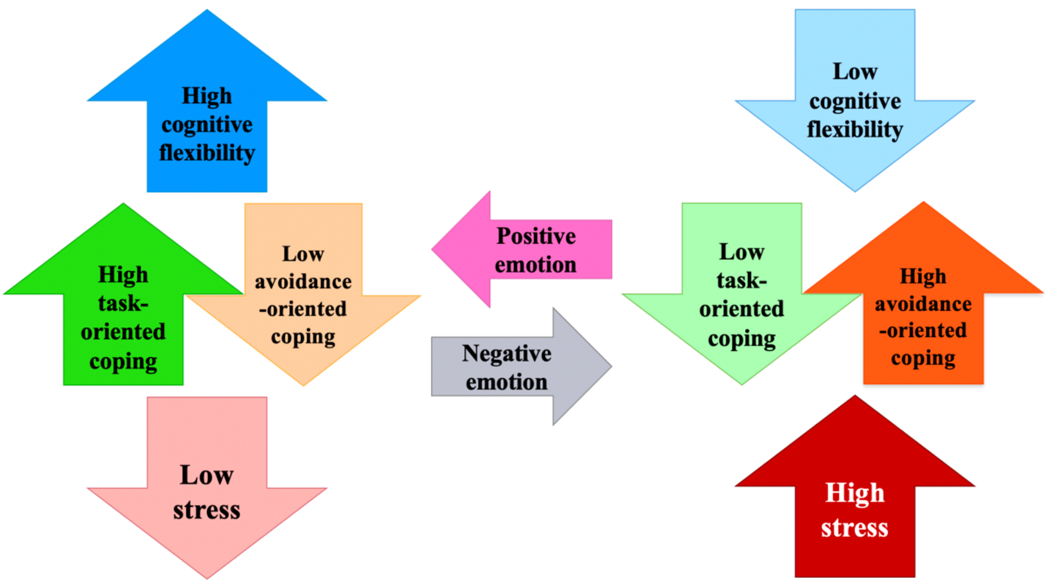
4.2.5 Hypotheses

This study aimed to identify whether cognitive flexibility and task-oriented coping strategies could promote pilots' non-technical skills (self-management skills in the management of stress) to work effectively in a high-stress environment and still be able to sustain their flying performance leading to a safer outcome. The hypotheses developed for the research are:

$\boldsymbol{H_1}$ Levels of stress among airline pilots are predicted to be negatively correlated with cognitive flexibility and task-oriented coping strategies. However, levels of stress among airline pilots are predicted to be positively correlated with emotion- and avoidance-oriented coping strategies. The hypothesised relationships for these factors are shown in Figure 4.6.

Figure 4.6

Hypothesised Relationship Between Stress, Cognitive Flexibility and Use of the Three Coping Strategies



$\boldsymbol{H_2}$ Cognitive flexibility levels among airline pilots are predicted to be positively correlated with task-oriented coping strategies but negatively correlated with emotion- and avoidance-oriented coping strategies.

$\boldsymbol{H_3}$ The degree to which airline pilots adopt emotion-oriented coping strategies is predicted to be negatively correlated with the degree to which they adopt task-oriented coping strategies, but positively correlated with the degree to which they adopt avoidance-oriented coping strategies. Conversely, the degree to which airline pilots adopt task-oriented coping strategies is predicted to be negatively correlated with the degree to which they adopt avoidance-oriented coping strategies.

$\boldsymbol{H_4}$ Based on hours of flying experience, airline pilots with more flying hours are expected to have lower stress levels and higher cognitive flexibility levels and adopt a greater degree of task-oriented coping strategies; whereas airline pilots with fewer flying hours are expected to have higher stress levels and lower cognitive flexibility levels and adopt a greater degree of emotion- and avoidance-oriented coping strategies.

$\boldsymbol{H_5}$ Airline pilots' stress levels are expected to decrease, and their cognitive flexibility levels increase, as their number of years of flying experience increases. Likewise, pilots with more years of experience are expected to adopt a greater degree of task-oriented coping strategies, whereas pilots with fewer years of experience are expected to adopt a greater degree of emotion- and avoidance-oriented coping strategies.

$\boldsymbol{H_6}$ With respect to increased workload, airline pilots who have more accumulated annual flying hours are expected to have higher stress levels and lower cognitive flexibility levels and adopt a lesser degree of task-oriented and greater degree of emotion- and avoidance-oriented coping strategies than airline pilots with less accumulated annual flying hours.

$\boldsymbol{H_7}$ Stress levels are expected to decrease, and cognitive flexibility to increase, with increasing age. Older pilots are expected to adopt task-oriented coping strategies to a greater degree, whereas younger pilots are expected to adopt emotion- and avoidance-oriented coping strategies to a greater degree.

$\boldsymbol{H_8}$ The group of captains is expected to show lower stress levels and higher cognitive flexibility levels than the group of co-pilots. Furthermore, captains are expected to adopt task-oriented coping strategies to a greater degree, but emotion- and avoidance-oriented coping strategies to a lesser degree, than co-pilots.

To test these hypotheses, the survey was focused on an understanding of how cognitive flexibility and task-oriented coping strategies could determine airline pilots' stress levels when working in the high-risk environment of aviation.

4.2.6 Ethics

The National Health and Medical Research Council, the Australian Research Council and Universities Australia (2018) state that human research is research conducted with or about people, or their data or tissue, and that contributes enormously to human good. Human participation in research can include their involvement through:

- taking part in surveys, interviews or focus groups
- undergoing psychological, physiological, or medical testing or treatment
- being observed by researchers
- researchers having access to their personal documents or other materials
- the collection and use of their body organs, tissues, or fluids (e.g., skin, blood, urine, saliva, hair, bones, tumour and other biopsy specimens) or their exhaled breath
- access to their information (in individually identifiable, re-identifiable or non-identifiable form) as part of an existing published or unpublished source or database.

Therefore, human research in Australia must be carried out in a safe and ethically responsible manner. Institutions are responsible for establishing procedures for the ethical review of human research to consider whether the research is associated with low or high risk.

To comply with the *National Statement on Ethical Conduct in Human Research* guidelines, this research design was submitted to the USQ HRE Committee for an expedited review process because this study was considered to represent low-risk research. The research was granted full ethical approval and confirmed as 'low risk' under HRE ID: H19REA301 (v1). The acknowledgment of ethics approval is presented in Appendix 4.

4.3 Results

Dempster and Hanna (2015) advise that a quantitative results section consists of two types of result: descriptive and inferential statistical test results. Descriptive statistics provide an overview of the data and allow comparison to other studies by presenting a comprehensible quantitative description in a manageable form, and represent a simple summary of samples and measures (Dempster & Hanna, 2015). With this type of statistic, the researcher can present a large amount of data to readers in a sensible way. Inferential statistical analyses are typically distinguished from descriptive statistics and are used to make inferences about the broader population based on the results from a smaller group. This type of statistical analysis offers insight regarding the probability of a result arising in the population; that is, whether it is a dependable result, or whether it happened by chance during the study. With this type of statistic, analyses directly address hypotheses or research aims.

According to the above, the statistical analyses in this chapter begin with a descriptive statistics summary of data from the JSS, the CFI and the CISS questionnaires, followed by inferential statistics in response to each hypothesis. The IBM SPSS statistics program (v. 26 for Mac) was used for statistical analyses in this study.

4.3.1 Descriptive Statistics Summary for Each Questionnaire

The aim of this section is to present the airline pilots' responses to the JSS, the CFI and the CISS in the form of whether this group mostly provided high, average, or low scores compared with standard scores for these questionnaires. The statistical results are presented in the form of descriptive statistics to provide an overview of the data. By reviewing these statistics, readers are informed of participants' characteristics.

4.3.1.1 Overall Response Results for the JSS Questionnaire

The JSS standard scoring was derived from the JSS manual, which presents a score ranging from 0.0 to 79.8. Individuals with lower JS-X scores show a minor degree of stress, whereas individuals with higher JS-X scores show a greater degree of stress. The JSS standard *T*-score and percentile conversion for managerial/professional employees or higher occupational group (total samples) was selected as comparable to the group of airline pilots in this study, as explained in Section 4.2.3.2.

As stipulated regarding JSS standard scoring for managerial/professional employees, Spielberger and Vagg (1999) explain that the *T*-score is a linear transformation of the raw JSS score and has a mean of 50 and standard deviation of 10. Spielberger and Vagg (1999) advise that a *T*-score of 60 (or percentile of 85) can be used as a convenient cut-off score to indicate an individual who experiences substantially greater stress than the normative group. Converting the JSS *T*-score of 60 results in a raw score of 30.74. For the purpose of statistical analysis, the researcher chose to follow the JSS manual in using a *T*-score of 60 (raw JS-X score of 30.74) as the cut-off score for categorising pilots into two groups: (1) the group of pilots with higher stress (HS) than average (≥30.75) (the 'HS group'); and (2) the group of pilots with average stress (AS) relative to the normative group (≤30.74) (the 'AS group').

The raw JS-X scores for the 77 airline pilots who responded to this survey ranged from 0.17 to 49.07, with a mean of 17.92 (*SD* = 10.86). Twelve pilots were placed into the HS group, with stress scores of 31.97–49.07; mean 37.58 (*SD* = 4.97). The 65 pilots in the AS group had scores ranging from 0.17 to 28.27; mean 14.30 (*SD* = 7.06). These numbers indicate that the majority of airline pilots (84.4%) had average scores relative to the normative group, while a minority (15.6%) had higher stress scores than the normative group. The JSS descriptive statistics are summarised in Table 4.5.

Table 4.5

Descriptive Statistics for the JSS Based on the Responses of Airline Pilots

Group of participants	**%**	**Possible range of scores**	**Observed range of scores**	***M***	***SD***
Total participants (*n* = 77)	100	0.00–79.80	0.17–49.07	17.92	10.86
HS group (*n* = 12)	15.6	30.75–79.80	31.97–49.07	37.58	4.97
AS group (*n* = 65)	84.4	0.00–30.74	0.17–28.27	14.30	7.06

4.3.1.2 Overall Response Results for the CFI Questionnaire

CFI standard scores range from 20 to 140. Individuals with lower CFI scores show greater cognitive rigidity, whereas those with higher CFI scores show greater cognitive flexibility. The 77 airline pilots who responded to this survey (see Table 4.6) had CFI scores that ranged from 88 to 135; mean 117.12 (*SD* = 10.00). Unfortunately, the scale developers did not establish standard cut-off scores for high, moderate, and low CFI total scores, as informed by Nitz (2020).

Table 4.6

Descriptive Statistics for the CFI Based on the Responses of Airline Pilots

Group of participants	%	Possible range of scores	Observed range of scores	*M*	*SD*
Total participants (n = 77)	100	20–140	88–135	117.12	10.00

4.3.1.3 Overall Response Results for the CISS Questionnaire

The 48-item CISS questionnaire is comprised of three main scales: task-, emotion- and avoidance-oriented coping. Each scale consists of 16 items with a standard raw score ranging from 16 to 80. Individuals with higher test scores in any coping dimensions show a greater degree of use of that particular type of coping strategy. Also, note that the standard cut-off raw score for high, average, and low for each coping dimension differs between males and females. Therefore, the raw scores must be converted to *T*-scores so that each scale has the same mean and standard deviation, which permits the interpreter to directly compare scores between scales, as recommended in the CISS manual (Endler & Parker, 1990, 1999).

As recommended by Endler and Parker (1990, 1999) in the CISS *T*-score interpretive guidelines, scores can be classified into nine grades as explained in Section 4.2.3.4. The CISS authors also advise that these *T*-scores represent a general rule-of-thumb, and the suggested guidelines are only approximate numbers, which do not have to be used as absolute rules. For this reason, to create a practical rule to apply to the descriptive statistical results in this study, three cut-off scores were devised: a *T*-score of 61 or above for high; 40–60 for average; and 39 or below for low scores. Full *T*-score conversion to raw scores is presented in Table 4.3. This approach clearly showed that pilots who achieved a 'high' score in any coping dimension were likely to apply the associated type of coping strategy, while pilots who attained a 'low' score in any coping dimension were less likely to use the associated type of coping strategy. Pilots who scored in the medium range were likely influenced by external factors and thus the likelihood of use of any particular coping strategy could not be determined.

It must be noted that *T*-score values were used only as cut-off points to indicate whether an individual had high, average, or low scores for each coping dimension (as shown in Table 4.7), to provide a general idea of descriptive statistics for the sample. However, inferential statistical analyses are presented in the form of raw scores for each coping strategy.

Table 4.7

CISS T-Score Conversion to Raw Scores

***T*-scores**	**Task-oriented**		**Emotion-oriented**		**Avoidance-oriented**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
61 and above	70 and above	68 and above	52 and above	55 and above	49 and above	56 and above
40 – 60	49 – 69	50 – 67	28 – 51	31 – 54	29 – 48	34 – 55
39 and below	48 and below	49 and below	27 and below	30 and below	28 and below	33 and below

Descriptive statistics for the 77 airline pilots who responded to this survey show that their CISS task-oriented coping *T*-scores ranged from 39 to 71; mean 56.70 (*SD* = 7.17). Nineteen of the pilots (24.7%) obtained high scores, and their *T*-scores ranged from 61 to 71; mean 66.26 (*SD* = 3.33). There were 56 pilots (72.7%) who obtained average scores, and their *T*-scores ranged from 46 to–60; mean 54.09 (*SD* = 4.18). Only two pilots (2.6%) obtained low scores, and their *T*-scores were both 39. These results are summarised in Table 4.8.

Table 4.8

Descriptive Statistics for the CISS Based on the Responses of Airline Pilots

Group of participants	%	Possible range of *T*-scores	Observed range of *T*-scores	*M*	*SD*
Task-oriented coping dimension					
Total participants (*n* = 77)	100	25–75	39–71	56.70	7.17
High (*n* = 19)	24.7	61–75	61–71	66.26	3.33
Average (*n* = 56)	72.7	40–60	46–60	54.09	4.18
Low (*n* = 2)	2.6	25–39	39	39.00	-
Emotion-oriented coping dimension					
Total participants (*n* = 77)	100	25–75	31–67	45.90	8.52
High (*n* = 6)	7.8	61–75	62–67	63.33	1.86
Average (*n* = 51)	66.2	40–60	40–60	47.55	5.71
Low (*n* = 20)	26.0	25–39	31–39	36.45	2.59
Avoidance-oriented coping dimension					
Total participants (*n* = 77)	100	25–75	28–75	54.31	10.25
High (*n* = 14)	18.2	61–75	62–75	70.50	5.53
Average (*n* = 58)	75.3	40–60	42–57	52.02	5.58
Low (*n* = 5)	6.5	25–39	28–39	35.60	4.51

For the CISS emotion-oriented coping dimension, pilots' *T*-scores ranged from 31 to 67; mean 45.90 (*SD* = 8.52). Six pilots (7.8%) obtained high *T*-scores ranging from 62 to 67; mean 63.33 (*SD* = 1.86). There were 51 pilots (66.2%) who obtained average *T*-scores of 40–60; mean 47.55 (*SD* = 5.71). Finally, 20 pilots (26.0%) obtained low *T*-scores from 31 to 39; mean 36.45 (*SD* = 2.59).

For CISS avoidance-oriented coping, *T*-scores for these pilots ranged from 28 to 75; mean 54.31 (*SD* = 10.25). Fourteen pilots (18.2%) who obtained high *T*-scores of 62–75; mean 70.50 (*SD* = 5.53). There were 58 pilots (75.3%) who obtained average

T-scores of 42–57; mean 52.02 (*SD* = 5.58). Only five pilots (6.5%) obtained low *T*-scores in the range of 28 to 39; mean 35.60 (*SD* = 4.51).

In summary, the descriptive statistic results give the general idea that the majority of airline pilots had stress scores at the average level. The statistics also show that most had engaged in emotion-, task- and avoidance-oriented coping strategies at an average level. Only a small number of the airline pilots had high stress scores. This could be due to the factors of different age, gender, level of flying experience, rank, or higher workload. Therefore, the inferential statistic is required to investigate which factor may have influenced pilots to have high stress scores. Furthermore, engagement with high emotion-oriented coping, but low task- and avoidance-oriented coping strategies was apparent for only a small number of pilots. This information represents the general characteristics of the airline pilot group compared with the normative groups used in this study.

4.3.2 Inferential Statistics for Testing Hypotheses

Statistical analyses were performed in response to each hypothesis and the results are presented in the form of inferential statistics. The IBM SPSS statistics program v. 26 for Mac was used for statistical analysis of these hypotheses. The statistical significance threshold was set to $p < .05$ for all statistical analyses.

4.3.2.1 Statistical Tests Applied for Hypothesis Testing

In this chapter, the researcher investigates questions relating to (1) the relationships between stress levels, cognitive flexibility levels and the degree to which airline pilots adopted different coping strategies; and (2) differences in these variables between different groups of airline pilots. Accordingly, this study applied the inferential statistical analysis tests outlined in the correlational and experimental research design, specifically an independent groups design, to validate these hypothesis questions.

4.3.2.1.1 Pearson product-moment correlation coefficient

Many types of correlation coefficient can be used to test hypotheses in a correlational research design. For example, a bi-serial correlation coefficient is used for samples in which one or both variables are dichotomous, Spearman's correlation coefficient can be applied to data that naturally occur in the form of ranks, and Kendall's tau coefficient is suitable for a small sample size with many tied ranks (Howell, 2012). For this study, the Pearson product-moment correlation coefficient, or Pearson's correlation was considered the most appropriate test to apply to H_1, H_2 and H_3 because the three questionnaires employ continuous scales.

Pearson's correlation is a parametric test that examines the degree of relationship between two variables to identify how a change in one variable is related or not to a change in another (Hanna & Dempster, 2012). This parametric statistic can enable powerful and accurate estimates but only if its assumptions are met. Failure to check these assumptions can create the risk of performing inappropriate analyses, which will lead to incorrect results and conclusions for a study. Hanna and Dempster (2012) advise that before running this test, the following three assumptions must be met: (1) variables must be measured at the ratio or interval level; (2) data for both variables must approximate a normal distribution; and (3) there can be no substantial extreme scores or outliers. These assumptions were reviewed and satisfied before running Pearson's correlation analyses on H_1–H_3 in this study.

The non-parametric Kruskal–Wallis test is used to test H_4–H_8, as these aim to examine three or more independent variables, whereas the parametric independent-samples *t*-test (more simply, the independent *t*-test) is applied to test H_8, which attempts to examine two variables (i.e. captains *v*. co-pilots). However, before running these statistical tests, the researcher assessed their assumptions, as follows.

4.3.2.1.2 Kruskal–Wallis test

The non-parametric Kruskal–Wallis test was chosen to evaluate hypotheses relating to variables categorised into three or more groups; for example, four groups with different total flying hours or five different age groups. A one-way between-group analysis of variance (ANOVA) parametric test is not suitable for H_4–H_7 because when the residual scores were tested using the Kolmogorov–Smirnov test of the difference between a score and its group mean, some scores were not normally distributed. Hanna and Dempster (2012) point out that the Kruskal–Wallis test is less stringent and considered free from assumptions. However, the following conditions must be met for the test to be validly used: (1) the independent variable should be categorical; and (2) the dependent variable should be measured at the ordinal level. Hanna and Dempster (2012) add that this type of statistical analysis has more flexibility for use with a more diverse range of data types because it is distribution free and can be applied to samples of any size.

Additionally, the Tukey honestly significant difference test (more simply, the Tukey post hoc test) is applied when a statistically significant difference is detected by the Kruskal–Wallis test. The Tukey post hoc test can indicate where significant differences lie between all possible pairs of groups, by examining the mean or median scores of each group and can identify which groups show statistically significant differences from each other.

4.3.2.1.3 Independent *t*-test

The independent *t*-test is a parametric statistic that assesses the difference between two independent groups for a particular variable (Hanna & Dempster, 2012). However, as with other parametric tests, certain assumptions must be met for the independent *t*-test to produce a powerful and accurate test result: (1) the level of measurement must be at an interval/ratio level; (2) the data must be normally distributed, which should be assessed for a sample larger than 30 people in total, and for each group; and (3) the variance must be approximately equal for the two groups. Having ensured these assumptions were met, the researcher applied the independent *t*-test to H_8, as the captains and co-pilots represented two independent groups to be compared.

4.3.2.2 Statistical Significance Considerations

Hanna and Dempster (2012) suggest that inferential statistics must provide at least 95% certainty for a null hypothesis to be rejected. To accept an alternative hypothesis, the probability that the relevant result could be achieved by chance must be less than 5% per cent. Therefore, when conducting inferential statistical tests, the likelihood, or *p* (significance) value must be less than 0.05 to conclude a statistically significant difference and thus accept the alternative hypothesis. Hanna and Dempster (2012) also advise that all inferential statistical tests are based on probability. Thus, there cannot be 100% certainty that a conclusion is absolutely proven. There is always some chance that the statistical result could be incorrect, leading to an inaccurate conclusion. For this reason, Hanna and Dempster (2012) highlight two types of error, Type I and Type II, that can result from an inferential statistical test.

4.3.2.2.1 Type I error

Type I error occurs when a statistically significant difference is identified by the *p* value (≤ 0.05), so the null hypothesis is rejected, when in reality there is no difference. Hanna and Dempster (2012) explain that the null hypothesis could be rejected because (1) it is not true or (2) is true but the sample size is unusual (Type I error). However, nobody knows exactly whether the null hypothesis is actually true or not, thus it should be convinced by relevant knowledge or similar results from other studies. Hanna and Dempster (2012) also indicate that the maximum chance of making a Type I error is 5%.

4.3.2.2.2 Type II error

Type II error happens when there is no statistically significant difference in the sample population and thus the null hypothesis is not rejected (Hanna & Dempster, 2012), but in reality, a difference does exist but was not detected by the inferential statistical test. Hanna and Dempster (2012) explain that a null hypothesis might not be rejected because (1) it is true or (2) it is not true, but the difference was not detected by the inferential statistical test (Type II error). One reason that a difference might not be identified is that the power of the test is low because the sample size is too small (Hanna & Dempster, 2012). Hanna and Dempster (2012) suggest that the maximum acceptable chance of making a Type II error is 20%.

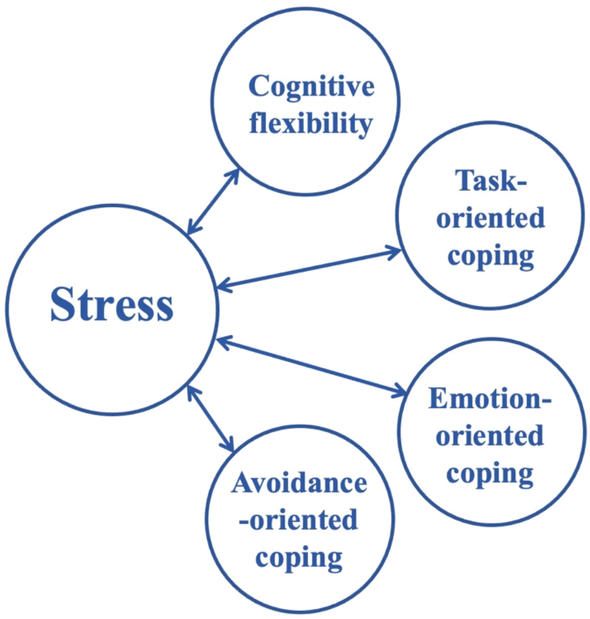
4.3.2.3 Testing H_1

$\boldsymbol{H_1}$ *Levels of stress among airline pilots are predicted to be negatively correlated with cognitive flexibility and task-oriented coping strategies. However, levels of stress among airline pilots are predicted to be positively correlated with emotion- and avoidance-oriented coping strategies.*

The first hypothesis aimed to examine the relationship between stress versus cognitive flexibility levels, and the degree of adoption of task-, emotion- and avoidance-oriented coping strategies, to determine whether these factors were related in the group of airline pilots. Accordingly, the 77 airline pilots' responses were investigated in regard to four dimensions: (1) the relationship between stress levels and cognitive flexibility levels; (2) the relationship between stress level and the degree to which they adopted task-oriented coping strategies; (3) the relationship between stress level and the degree to which they adopted emotion-oriented coping strategies; and (4) the relationship between stress level and the degree to which they adopted avoidance-oriented coping strategies (hypothesised relationships shown in Figure 4.7).

Figure 4.7

H_1—Hypothesised Relationships Between Stress, and Cognitive Flexibility and the Three Coping Strategies



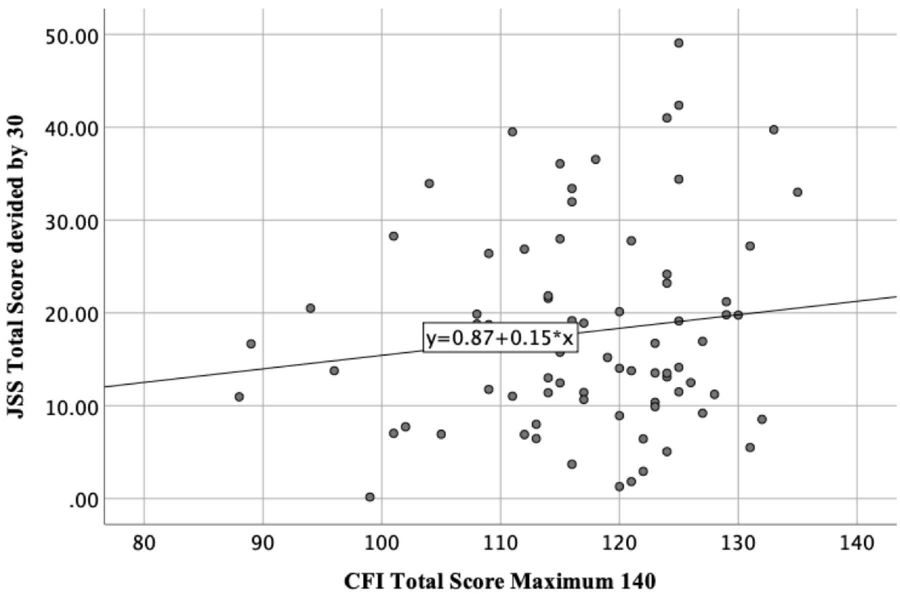
The Pearson product-moment correlation coefficient was applied to test hypotheses designed to assess relationships between two or more variables. Before utilising this parametric test, its assumptions were checked, which confirmed that (a) the sample size was larger than 30, in which case a normal distribution was assumed; (b) there were no extreme scores or outliers evident on scatterplots; and (c) all variables were measured at the interval level. This ensured that all inferences in the H_1–H_3 stemmed from the most appropriate statistical test, which led to the most accurate and powerful statistical results.

4.3.2.3.1 Stress versus cognitive flexibility

The first part of H_1 refers to the relationship between stress levels and cognitive flexibility levels: it was hypothesised that airline pilots with lower stress scores will have higher cognitive flexibility scores, and vice versa. To test this hypothesis, the Pearson product-moment correlation coefficient was computed to assess the relationship between the CFI and JSS scores. The results reveal a moderately positive correlation between the two scores (see Figure 4.8), suggesting that an increase in CFI levels was associated with an increase in stress levels, but the relationship was not statistically significant: r (75) = .134, 95% BCa CI [–.104, .323], p = .245. Thus, this finding did not support the first part of H_1.

Figure 4.8

Scatterplot Displaying the Relationship Between JSS and CFI Scores

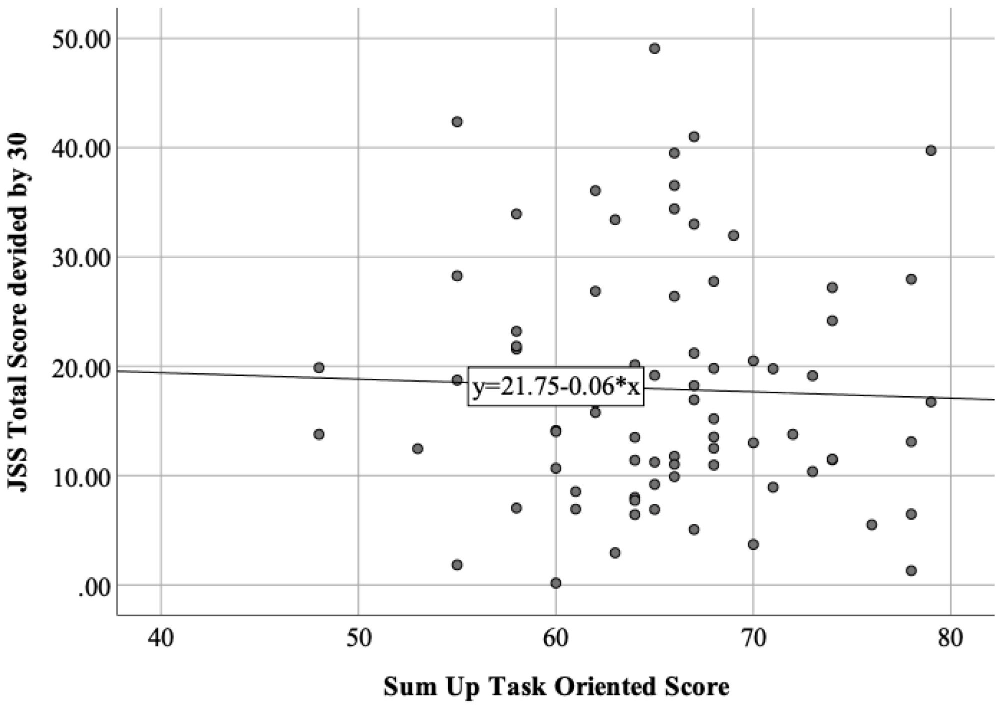


4.3.2.3.2 Stress versus task-oriented coping strategies

The second part of H_1 aimed to investigate the relationship between stress levels and the task-oriented coping dimension: it was hypothesised that airline pilots who adopted task-oriented coping strategies to a higher degree would show lower stress levels when experiencing stressors. A Pearson's correlation test was performed to investigate the relationship between JSS scores and CISS task-oriented coping scores. The results show that the slightly negative correlation between the two scores (see Figure 4.9) was not statistically significant: r (75) = –.037, 95% BCa CI [–.262, .181], $p = .752$. This suggests that the degree to which the pilots adopted task-oriented coping strategies was only moderately associated with their stress levels; thus, the evidence was not sufficient to support the second part of H_1.

Figure 4.9

Scatterplot Displaying the Relationship Between JSS and CISS Task-oriented Coping Dimension Scores

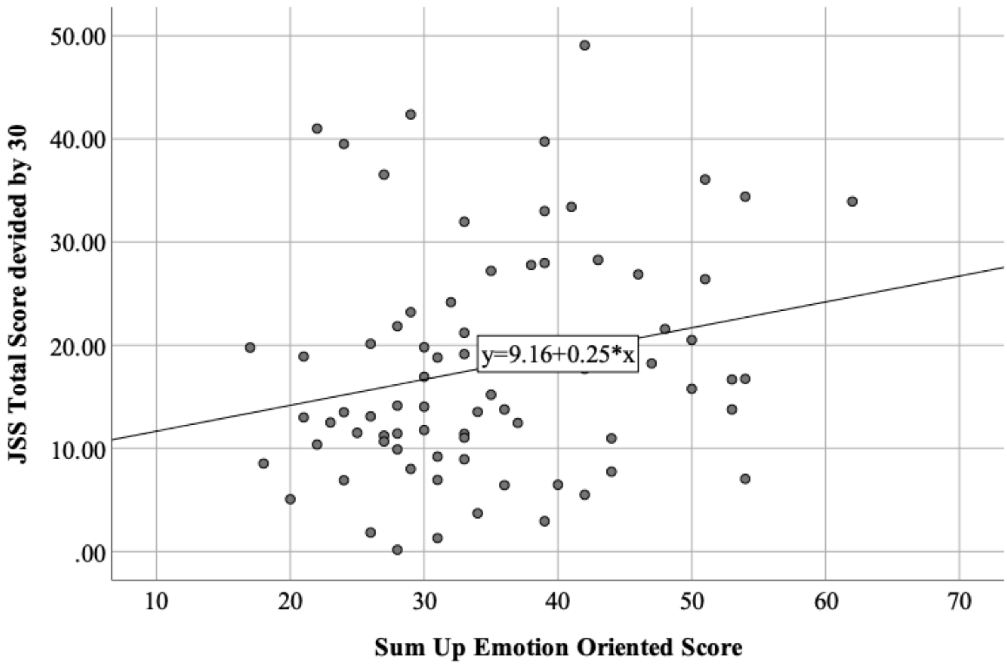


4.3.2.3.3 Stress versus emotion-oriented coping strategies

The third part of H_1 aimed to examine the relationship between stress levels and the emotion-oriented coping dimension: it was hypothesised that airline pilots with higher stress levels would adopt emotion-oriented coping strategies to a higher degree to cope with stress. A Pearson's correlation test was utilised to analyse the JSS scores and the CISS emotion-oriented coping dimension scores, revealing a statistically significant correlation between the two scores (see Figure 4.10): r (75) = .231, 95% BCa CI [.023, .450], p = .043. This suggests that the pilots who adopted emotion-oriented coping strategies to a higher degree had higher stress levels than pilots who adopted this type of coping method to a lower degree of, which supports the third part of H_1.

Figure 4.10

Scatterplot Displaying the Relationships Between JSS Scores and CISS Emotion-oriented Coping Dimension Scores

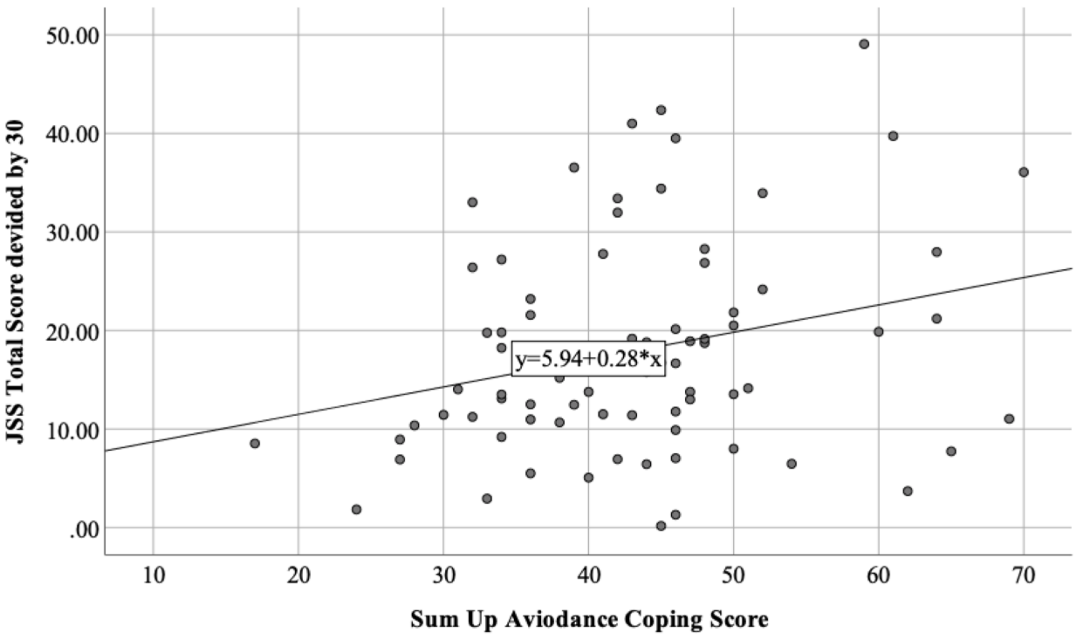


4.3.2.3.4 Stress versus avoidance-oriented coping strategies

The last part of H_1 refers to the relationship between stress levels and the avoidance-oriented coping dimension: it was hypothesised that airline pilots who adopted avoidance-oriented coping strategies to a higher degree would have higher stress levels. To test this hypothesis, a Pearson's correlation test was utilised to compare the JSS and CISS avoidance-oriented coping dimension scores. The results reveal a statistically significant correlation between these two scores (see Figure 4.11): r (75) = .268, 95% BCa CI [.028, .479], p = .018; thus, the degree to which airline pilots adopted avoidance-oriented coping strategies was positively associated with their stress levels. This finding supports one part of H_1.

Figure 4.11

Scatterplot Displaying the Relationship Between JSS Scores and CISS Avoidance-oriented Coping Dimension Scores



4.3.2.3.5 H_1 testing summary

In summary, analysis of this dataset did not statistically validate the idea that the airline pilots' stress levels were negatively correlated with their cognitive flexibility or the degree to which they adopted task-oriented coping strategies. However, the results indicate that pilots who emotion- and avoidance-oriented coping strategies to a greater degree had significantly higher stress levels when they tried to cope with stressors. Therefore, half of H_1 is supported by the statistical results.

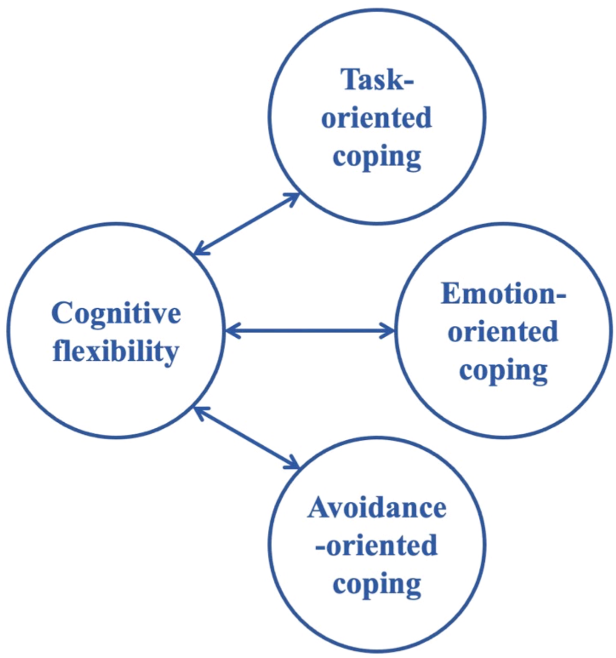
4.3.2.4 Testing H_2

***H_2** Cognitive flexibility levels among airline pilots are predicted to be positively correlated with task-oriented coping strategies but negatively correlated with emotion- and avoidance-oriented coping strategies.*

In this hypothesis, the relationship between cognitive flexibility level and each of three types of coping strategy was examined to determine whether airline pilots' cognitive flexibility was associated with their preferred coping strategies. To investigate these relationships, three dimensions were examined: (1) the relationship between pilots' cognitive flexibility levels and the degree to which they adopted task-oriented coping strategies; (2) the relationship between pilots' cognitive flexibility levels and the degree to which they adopted emotion-oriented coping strategies; and (3) the relationship between pilots' cognitive flexibility levels and the degree to which they adopted avoidance-oriented coping strategies (hypothesised relationships shown in Figure 4.12).

Figure 4.12

H_2—Hypothesised Relationships Between Cognitive Flexibility and Each of the Three Coping Strategies

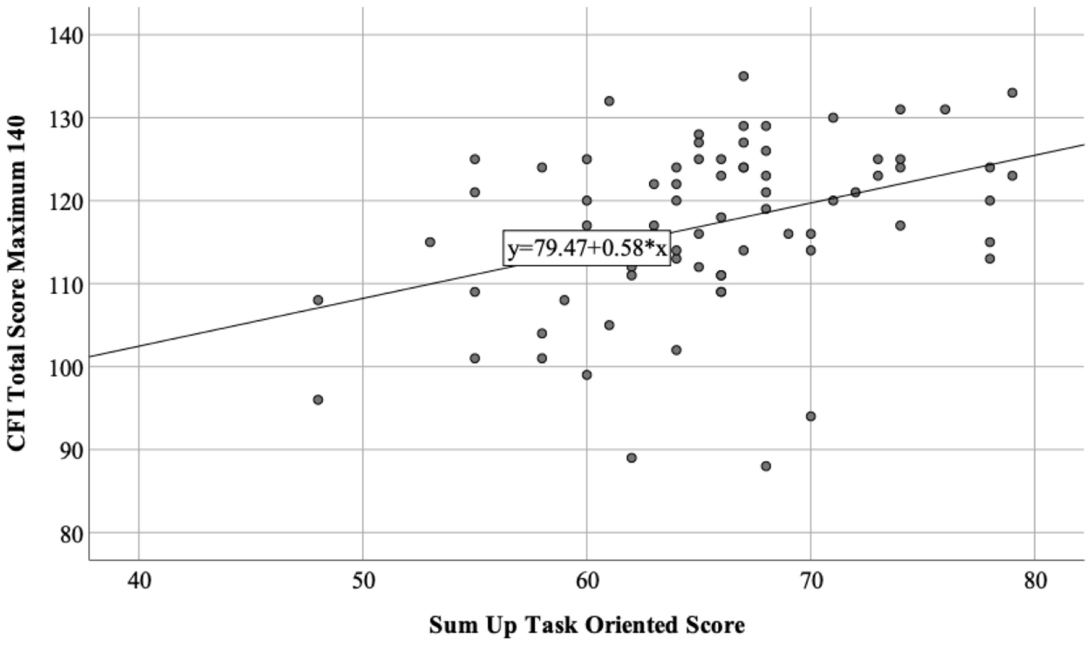


4.3.2.4.1 Cognitive flexibility versus task-oriented coping strategies

The first part of H_2 aimed to assess the relationship between cognitive flexibility and the task-oriented coping dimension: it was assumed that the group of airline pilots who showed greater cognitive flexibility would adopt task-oriented coping strategies to a higher degree. To test this hypothesis, a Pearson's correlation test was performed on the CFI and CISS task-oriented coping scores. The results reveal a statistically significant correlation between these two scores (see Figure 4.13): r (75) = .391, 95% BCa CI [.202, .568], p = < .001. This suggests that the group of airline pilots with greater cognitive flexibility levels adopted task-oriented coping strategies to a higher degree when dealing with a stressful situation, which supports the first part of H_2.

Figure 4.13

Scatterplot Displaying the Relationship Between CFI and CISS Task-oriented Coping Dimension Scores

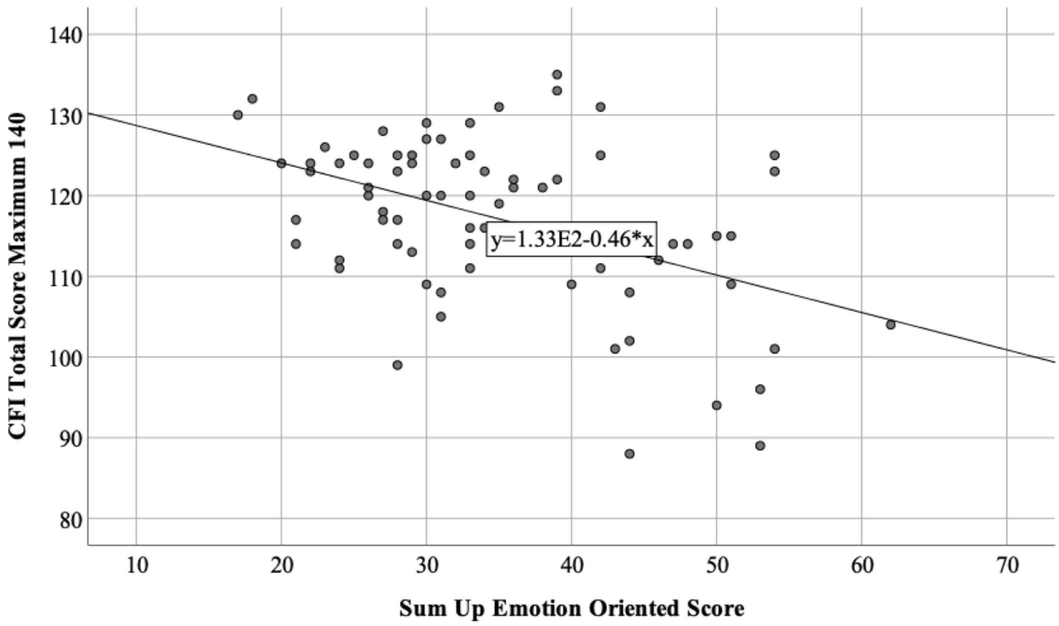


4.3.2.4.2 Cognitive flexibility versus emotion-oriented coping strategies

The next part of H_2 relates to the relationship between cognitive flexibility levels and the degree to which pilots adopted emotion-oriented coping strategies: it was presumed that the airline pilots with greater levels of cognitive flexibility would adopt emotion-oriented coping strategies to a lower degree when dealing with stress. To test this hypothesis, a Pearson's correlation test was performed to analyse the CFI and CISS emotion-oriented coping dimension scores. The results reveal a statistically significant negative correlation between the two scores (see Figure 4.14): r (75) = –.47, 95% BCa CI [–.640, –.265], p = < .001. This indicates that the pilots with greater cognitive flexibility were less likely to adopt emotion-oriented coping strategies when dealing with a stressful situation. This finding supports the second part of H_2.

Figure 4.14

Scatterplot Displaying the Relationship Between CFI and CISS Emotion-oriented Coping Dimension Scores

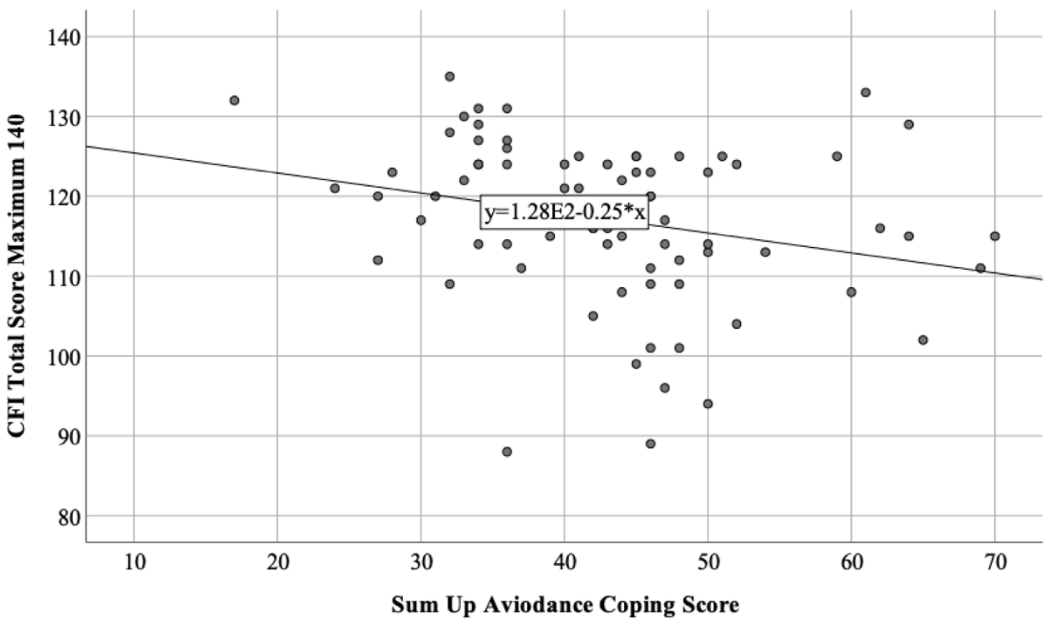


4.3.2.4.3 Cognitive flexibility versus avoidance-oriented coping strategies

The final part of H_2 refers to the relationship between pilots' cognitive flexibility levels and the degree to which they adopted avoidance-oriented coping strategies: it was predicted that the airline pilots with greater cognitive flexibility would adopt avoidance-oriented coping strategies to a lower degree when encountering stress. A Pearson's correlation test was computed between the CFI and CISS avoidance-oriented coping scores. The results show that there was a statistically significant negative correlation between these two scores (see Figure 4.15): r (75) = –.262, 95% BCa CI [–.453, –.041], p = .021. This suggests that airline pilots with a greater level of cognitive flexibility would adopt avoidance-oriented coping methods to a lesser degree of to cope with their stress. The results of this finding support the last part of H_2.

Figure 4.15

Scatterplot Displaying the Relationship Between CFI and CISS Avoidance-oriented Coping Dimension Scores



4.3.2.4.4 H_2 testing summary

The Pearson's correlation tests used to analyse this hypothesis support the idea that the airline pilots' preferred coping strategies were correlated with their cognitive flexibility levels: pilots with higher cognitive flexibility would adopt task-oriented coping strategies to a higher degree, whereas those with lower cognitive flexibility would adopt emotion- and avoidance-oriented coping methods to a higher degree when coping with a situation that induced stress. These findings provide complete support for H_2.

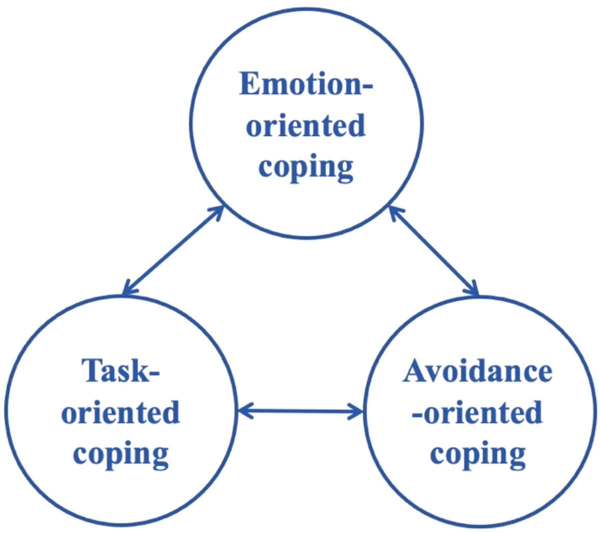
4.3.2.5 Testing H_3

H_3 *The degree to which airline pilots adopt emotion-oriented coping strategies is predicted to be negatively correlated with the degree to which they adopt task-oriented coping strategies, but positively correlated with the degree to which they adopt avoidance-oriented coping strategies. Conversely, the degree to which airline pilots adopt task-oriented coping strategies is predicted to be negatively correlated with the degree to which they adopt avoidance-oriented coping strategies.*

The third hypothesis was designed to examine the relationships between the three types of coping strategy, and whether one type was associated with pilots adopting another type of coping strategy. To investigate this question, three aspects were observed: (1) the relationship between use of emotion- and task-oriented coping strategies; (2) the relationship between use of emotion- and avoidance-oriented coping strategies; and (3) the relationship between use of task- and avoidance-oriented coping strategies (hypothesised relationship shown in Figure 4.16).

Figure 4.16

H_3–Hypothesised Relationships Between the Three Coping Strategies

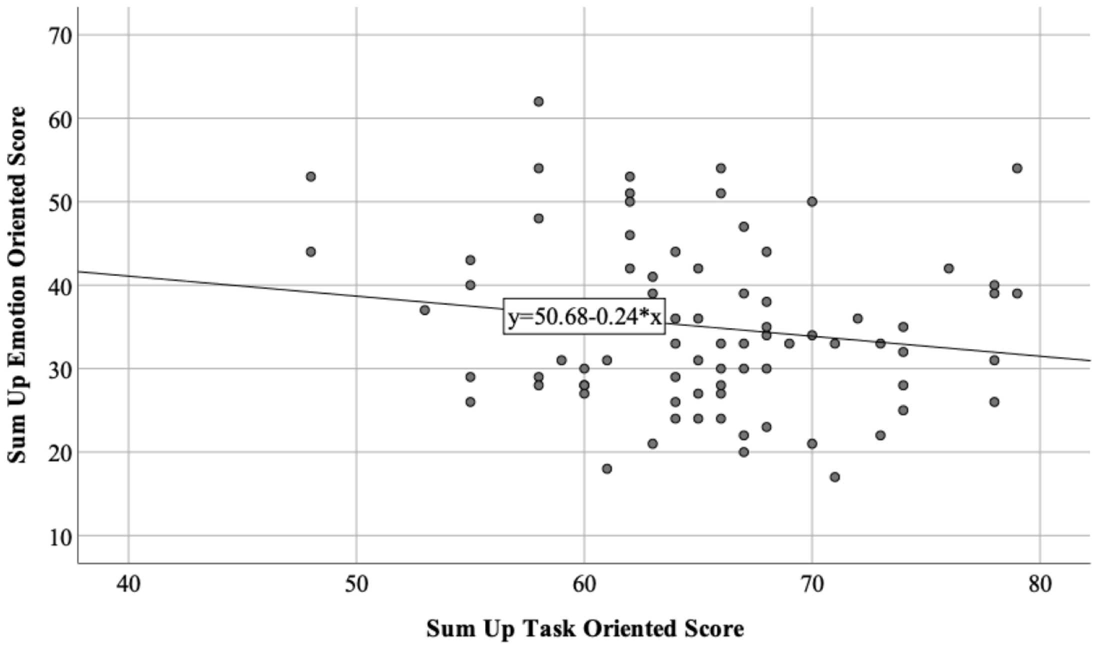


4.3.2.5.1 Emotion- versus task-oriented coping strategies

The relationship between the emotion- and task-oriented coping dimensions was examined primarily to determine whether the airline pilots who adopted emotion-oriented coping strategies to a greater degree would adopt task-oriented coping strategies when trying to a lesser degree in a stressful situation. To address this question, a Pearson's correlation test was performed on the CISS task- and CISS emotion-oriented coping scores. The results reveal a moderately negative (see Figure 4.17) but insignificant correlation between the two scores: r (75) = –.163, 95% BCa CI [–.380, .075], p = .157. This suggests that pilots who adopted negative emotion-oriented coping strategies to a lesser extent would adopt task-oriented coping strategies to a slightly higher degree to cope with stressors. This finding does not support the first part of H_3.

Figure 4.17

Scatterplot Displaying the Relationship Between the CISS Emotion- and Task-oriented Coping Dimension Scores

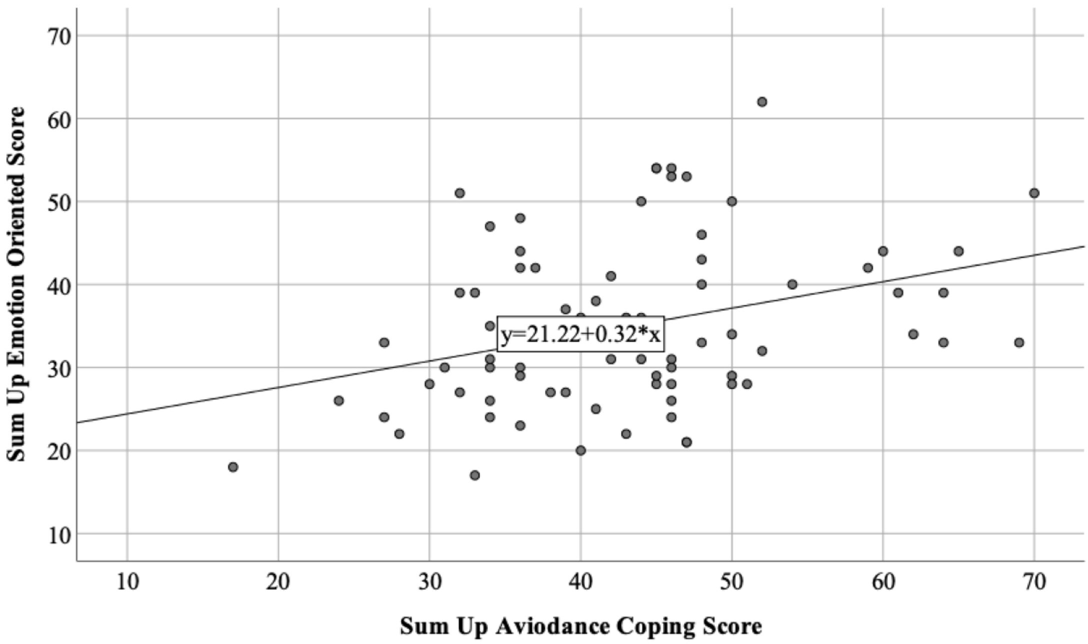


4.3.2.5.2 Emotion- versus avoidance-oriented coping strategies

The relationship between emotion- and avoidance-oriented coping was assessed to investigate whether higher adoption of emotion-oriented coping strategies was associated with airline pilots adopting avoidance-oriented coping strategies to a higher degree. To examine this, a Pearson's correlation test was applied to the CISS emotion- and CISS avoidance-oriented coping scores. The results show a statistically significant correlation between the two scores (see Figure 4.18)—r (75) = .333, 95% BCa CI [.148, .491], p = .003—suggesting that airline pilots who adopted emotion-oriented coping strategies to a greater degree were more likely to have negative emotions and prone to the use of avoidance-oriented coping strategies when encountering stressors. This finding supports the second part of H_3.

Figure 4.18

Scatterplot Displaying the Relationship Between CISS Emotion- and Avoidance-oriented Coping Dimension Scores

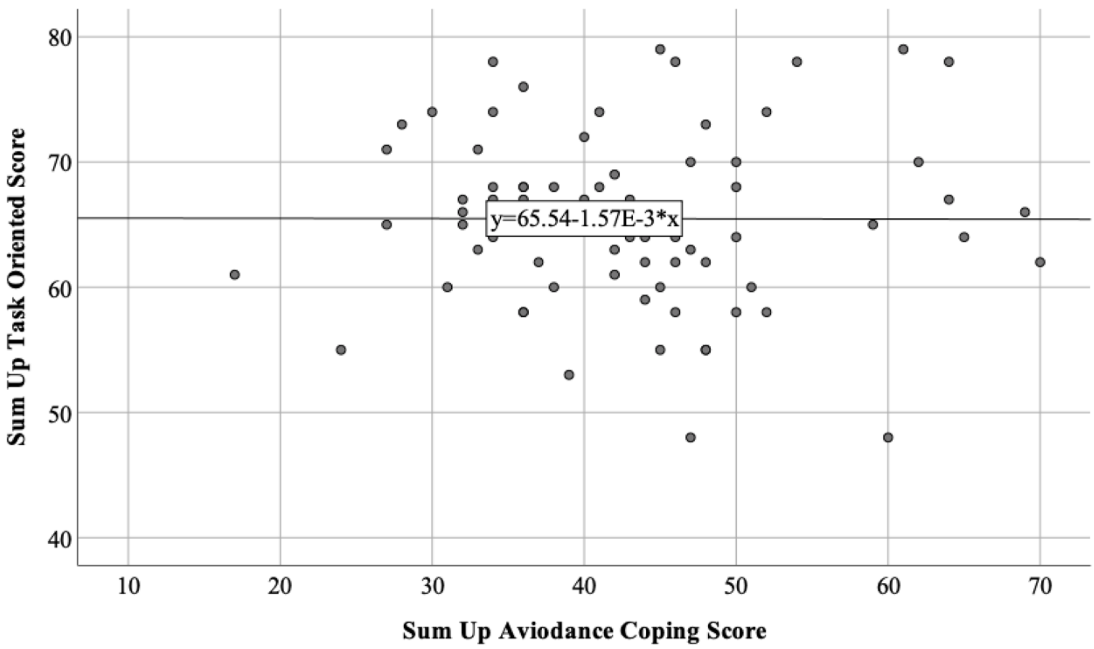


4.3.2.5.3 Task- versus avoidance-oriented coping strategies

The relationship between the task- and avoidance-oriented coping dimensions was tested to determine whether airline pilots who adopted task-oriented coping strategies to a greater degree would adopt avoidance-oriented coping strategies to a lesser degree when encountering stress. A Pearson's correlation test was performed on CISS task- and CISS avoidance-oriented coping scores. The results indicate no statistically significant correlation between these two scores (see Figure 4.19), r (75) = –.002, 95% BCa CI [–.246, .224], p = .983. This indicates that these airline pilots employed both coping strategies to a similar extent when coping with stressors. The results do not support this aspect of H_3.

Figure 4.19

Scatterplot Display of the Relationship Between CISS Task- and Avoidance-oriented Coping Dimension Scores



4.3.2.5.4 H_3 testing summary

In conclusion in relation to H_3, the statistical analysis results suggest that airline pilots who engaged in less negative emotion-oriented coping engages in task-oriented coping to a slightly higher degree, and in avoidance-oriented coping to a much lower degree than those who engaged in high emotion coping. However, findings on the correlation between task- and avoidance-oriented coping scores indicate that airline pilots would adopt both strategies to a similar degree when coping with stress. Overall, these results support only some parts of H_3.

4.3.2.6 Testing H_4

H_4 *Based on hours of flying experience, airline pilots with more flying hours are expected to have lower stress levels and higher cognitive flexibility levels and adopt a greater degree of task-oriented coping strategies; whereas airline pilots with fewer flying hours are expected to have higher stress levels and lower cognitive flexibility levels and adopt a greater degree of emotion- and avoidance-oriented coping strategies.*

This hypothesis was designed to investigate whether airline pilots' stress and cognitive flexibility levels, and the degree to which they adopted different coping strategies would be influenced by their total hours of flying. The survey collected data from four groups, but only three of these delivered responses (see Table 4.9): (1) the group of pilots with flying experience of 301–2,000 hours ('low experience pilots'; *n* = 9, 11.7%); (2) the group of pilots with flying experience of 2,001–5,000 hours ('moderate experience pilots'; *n* = 13, 16.9%); and (3) the group of pilots with flying experience of more than 5,000 hours ('high experience pilots'; *n* = 55, 71.4%).

Table 4.9

Summary Scores for Pilots With Different Amounts of Total Flying Experience From Their Responses to the JSS, CFI and in Regard to the Three Coping Strategies

Survey/scores \ Participant groups		JSS	CFI	Task	Emotion	Avoidance
	Min	0.17	88	48	17	17
	Max	49.07	135	79	62	70
	M	17.92	117.12	65.47	34.97	43.17
	SD	10.86	10.00	6.81	10.03	10.48
301–2,000 hours (*n* = 9, 11.7%)	Min	7.03	101	58	21	32
	Max	27.20	131	79	54	69
	M	14.86	117.11	68.89	36.37	43.22
	SD	7.35	9.90	6.96	12.91	12.03
2,001–5,000 hours (*n* = 13, 16.9%)	Min	0.17	89	55	23	30
	Max	27.97	126	78	53	65
	M	13.97	110.77	65.62	38.38	47.08
	SD	8.75	11.66	6.33	9.55	11.71
More than 5,000 hours (*n* = 55, 71.4%)	Min	1.30	88	48	17	17
	Max	49.07	135	79	62	70
	M	19.36	118.62	64.87	33.89	42.24
	SD	11.55	9.16	6.84	9.59	9.91
Total (77)						

The non-parametric Kruskal–Wallis test was chosen to test this hypothesis because some residual scores did not show a normal distribution (i.e. $p < .05$; hence, the null hypothesis was rejected) when testing with the Kolmogorov–Smirnov test (as shown in Figure 4.20). Therefore, it was not appropriate to use an ANOVA test on these data.

Figure 4.20

Residual Scores Tested by the Kolmogorov–Smirnov Test

One-Sample Kolmogorov-Smirnov Test

		Residual for JSS_Final	Residual for CFI_SUM_140	Residual for CISS_Task_Oriented	Residual for CISS_Emotion_Oriented	Residual for CISS_Avoidance
N		77	77	77	77	77
Normal Parameters[a,b]	Mean	.0000	.0000	.0000	.0000	.0000
	Std. Deviation	10.61046	9.56018	6.68273	9.86516	10.32524
Most Extreme Differences	Absolute	.107	.097	.073	.094	.105
	Positive	.107	.057	.073	.094	.105
	Negative	-.072	-.097	-.048	-.054	-.052
Test Statistic		.107	.097	.073	.094	.105
Asymp. Sig. (2-tailed)		.028[c]	.072[c]	.200[c,d]	.086[c]	.034[c]

4.3.2.6.1 Comparison of stress levels between the groups of low, moderate, and high experience pilots

The first part of H_4 aimed to identify whether pilots with higher total flying hours would experience lower stress levels than pilots with fewer total flying hours. A Kruskal–Wallis test was performed to determine whether there was a difference in stress levels between the groups of low, moderate and high experience pilots. The results indicate no statistically significant difference in stress levels between these three groups of pilots; $H(2) = 2.53$, $p = .28$. This suggests that pilots' stress levels were not affected by their total hours of flying experience, which does not support the first part of H_4.

4.3.2.6.2 Comparison of cognitive flexibility levels between the groups of low, moderate, and high experience pilots

The second part of H_4 hypothesised that pilots with more total flying hours would display greater cognitive flexibility than pilots with fewer total flying hours. A Kruskal–Wallis test was executed on the groups of pilots with low, moderate and high experience to test for a difference in their cognitive flexibility levels. The results show that these three groups' CFI scores were slightly different, but not significantly so: H (2) = 4.74, p = .09. Thus, pilots with different total hours of flying experience had a similar degree of cognitive flexibility.

4.3.2.6.3 Comparison of the degree to which task-oriented coping strategies are adopted, between the groups of low, moderate, and high experience pilots

This part of H_4 was developed to examine the degree to which pilots in the three groups adopted task-oriented coping strategies; it was hypothesised that those with more flying hours would adopt this type of coping methods to a greater degree. A Kruskal–Wallis test was administered to test for a difference in the degree to which pilots with low, moderate and high experience adopted the CISS task-oriented coping strategies. There was no statistically significant difference among the three groups—H (2) = 1.98, p = .37—showing that pilots with different total numbers of flying hours adopted task-oriented coping strategies to a similar degree when encountering stressful situations. This test thus provides no support for this part of H_4.

4.3.2.6.4 Comparison of the degree to which emotion-oriented coping strategies are adopted, between the groups of low, moderate, and high experience pilots

This part of H_4 investigates the degree to which pilots adopted emotion-oriented coping strategies; it was hypothesised that those with fewer flying hours would do so to a greater degree than those with higher flying hours. Kruskal–Wallis test results do not support the hypothesis of a statistically significant difference between the three groups on their CISS emotion-oriented coping scores: H (2) = 2.12, p = .35. This suggests that the number of flying hours did not influence the degree to which the pilots adopted emotion-oriented coping strategies and there is no support for the fourth part of H_4.

4.3.2.6.5 Comparison of the degree to which avoidance-oriented coping strategies are adopted, between the groups of low, moderate, and high experience pilots

The final investigation under this hypothesis focused on whether pilots with fewer flying hours would adopt avoidance-oriented coping strategies to a greater degree than those with more flying hours. A Kruskal–Wallis test was used to test for a difference in between pilots with low, moderate or high flying hours in their adoption of avoidance-oriented coping strategies. There was no statistically significant difference among these groups on their avoidance-oriented coping scores: H (2) = 2.12, p = .35. Thus, number of flying hours was not associated with use of avoidance-oriented coping strategies, and the last part of H_4 is not supported.

4.3.2.6.6 H_4 testing summary

In summary, number of flying hours did not alter pilots' stress or cognitive flexibility levels, or the degree to which they adopted any particular coping strategy: the results show that all three groups of pilots had similar scores for these factors. H_4 is not supported.

4.3.2.7 Testing H_5

H_5 *Airline pilots' stress levels are expected to decrease, and their cognitive flexibility levels increase, as their number of years of flying experience increases. Likewise, pilots with more years of experience are expected to adopt a greater degree of task-oriented coping strategies, whereas pilots with fewer years of experience are expected to adopt a greater degree of emotion- and avoidance-oriented coping strategies.*

This hypothesis concentrates on the number of years of flying experience for airline pilots; it was hypothesised that more years of flying would alter pilots' stress and cognitive flexibility levels as well as their preferred coping method. To test this, the pilots were categorised into four groups based on their number of years flying commercially (see Table 4.10): (1) 5 years or less ('advanced beginners'; n = 11, 14.3%); (2) 6–10 years ('competent'; n = 12, 15.6%); (3) 11–15 years ('proficient'; n = 19, 24.7%); and (4) more than 15 years ('expert'; n = 35, 45.5%).

Table 4.10

Summary Scores for Pilots With Different Years of Flying Experience From Their Responses to the JSS, CFI and in Regard to the Three Coping Strategies

Survey/scores / Participant group		JSS	CFI	Task	Emotion	Avoidance
	Min	0.17	88	48	17	17
	Max	49.07	135	79	62	70
	M	17.92	117.12	65.47	34.97	43.17
	SD	10.86	10.00	6.81	10.03	10.48
Flying commercially for 5 years or less (*n* = 11, 14.3%)	Min	7.03	101	58	21	32
	Max	27.20	131	79	54	69
	M	16.26	116.36	68.09	38.45	42.82
	SD	7.52	9.01	6.56	12.22	11.24
Flying commercially for 6–10 years (*n* = 12, 15.6%)	Min	0.17	89	53	23	34
	Max	28.27	127	70	53	65
	M	13.82	109.75	61.67	36.58	47.83
	SD	7.98	12.89	5.87	9.54	9.22
Flying commercially for 11–15 years (*n* = 19, 24.7%)	Min	5.50	88	48	22	27
	Max	41.00	133	79	53	70
	M	19.16	117.21	68.42	35.21	44.74
	SD	11.61	11.18	7.12	8.18	11.78
Flying commercially for more than 15 years (*n* = 35, 45.5%)	Min	1.30	104	48	17	17
	Max	49.07	135	78	62	64
	M	19.18	119.83	64.34	33.20	40.83
	SD	12.06	7.29	5.89	10.38	9.63
Total (77)						

4.3.2.7.1 Comparison of stress levels between groups of pilots with different numbers of years of flying

The initial aim was to inspect whether pilots' stress levels would be lower with more years of flying experience. A Kruskal–Wallis test was performed on the four pilot groups with different numbers of years of flying experience to identify any differences in their stress levels. The results show no statistically significant difference between the four groups on their JSS scores: H (3) = 1.56, p = .67. Thus, a higher number of years flying did not diminish the pilots' stress levels, finding no support for the first part of H_5.

4.3.2.7.2 Comparison of cognitive flexibility levels between groups of pilots with different numbers of years of flying

The next part of H_5 is related to whether pilots who have been flying longer would display greater cognitive flexibility levels than pilots with fewer years of flying experience. A Kruskal–Wallis test applied to the cognitive flexibility scores of the advanced beginner, competent, proficient and expert group of pilots revealed no statistically significant difference: H (3) = 5.91, p = .12. Thus, pilots' cognitive flexibility levels were not higher with increasing years of flying experience: pilots with fewer years of flying experience could show as high a level of cognitive flexibility as pilots with more flying experience. This result does not support this part of H_5.

4.3.2.7.3 Comparison of the degree to which task-oriented coping strategies are adopted, between groups of pilots with different numbers of years of flying

The third aspect of H_5 focuses on whether pilots with more years of flying experience would adopt task-oriented coping strategies to a greater degree. A Kruskal–Wallis test found a significant difference between the four groups in their task-oriented coping scores: H (3) = 10.55, p = .014. Post hoc comparisons using a Tukey HSD test show that the mean score for the group of proficient pilots (M = 68.42, SD = 7.72) was significantly (p = .03) higher than that for the group of competent pilots (M = 61.67, SD = 5.87). However, the groups of advanced beginners (M = 68.09, SD = 6.57) and expert pilots (M = 64.34, SD = 5.89) did not differ significantly from the groups of proficient and the competent pilots. This suggests that proficient pilots (those having flown for 11–15 years) adopted task-oriented coping strategies to a greater degree than competent pilots (6–10 years).

4.3.2.7.4 Comparison of the degree to which emotion-oriented coping strategies are adopted, between groups of pilots with different numbers of years of flying

The emotion-oriented coping dimension was examined to determine whether pilots with fewer years of flying experience would adopt this type of coping strategy to a greater degree than those with more years of flying experience. A Kruskal–Wallis test was performed to examine the differences between the four pilot groups in the degree to which they adopted emotion-oriented coping strategies. There was no statistically significant difference between the groups on their emotion-oriented coping mean scores: H (3) = 2.46, p = .48. This suggests that pilots adopted emotion-oriented coping strategies at a similar level regardless of how many years of experience they had. This result does not support this part of H_5.

4.3.2.7.5 Comparison of the degree to which avoidance-oriented coping strategies are adopted, between groups of pilots with different numbers of years of flying

Finally, the avoidance-oriented coping dimension was investigated as it was hypothesised that pilots with fewer years of flying experience would adopt this coping strategy to a greater degree than pilots with more years of flying experience. The Kruskal–Wallis test relating to this hypothesis reveals a statistically significant difference between the four groups on their avoidance-oriented coping mean scores: H (3) = 5.56, p = .14. Thus, the number of years of flying experience was not associated with the degree to which pilots adopted avoidance-oriented coping strategies, providing no support for this aspect of H_5.

4.3.2.7.6 H_5 testing summary

In conclusion, there were no significant differences in stress or cognitive flexibility levels, and the degree to which pilots adopted emotion- and avoidance-oriented coping strategies according to their number of years of expertise. However, the group of proficient pilots had significantly higher task-oriented coping scores than the group of competent pilots. This indicates that with more hours of flying experience in their career, pilots become more task-oriented with their coping methods.

4.3.2.8 Testing H_6

H_6 *With respect to increased workload, airline pilots who have more accumulated annual flying hours are expected to have higher stress levels and lower cognitive flexibility levels and adopt a lesser degree of task-oriented and greater degree of emotion- and avoidance-oriented coping strategies than airline pilots with less accumulated annual flying hours.*

H_6 focuses on whether pilots who fly more hours in a year (which increases their workload and responsibility) would show higher and lower cognitive flexibility levels and adopt task-oriented coping to a lower degree; instead adopting more emotion- and avoidance-oriented coping. To address this question, data were collected from airline pilots in four groups according to their number of annual accumulated flying hours (see Table 4.11): (1) 300 hours or less (Group A; *n* = 5, 6.5%); (2) 301–600 hours (Group B; *n* = 23, 29.9%); (3) 601–900 hours (Group C; *n* = 46, 59.7%); and (4) more than 900 hours (Group D; *n* = 3, 3.9%).

Table 4.11

Summary Scores for Pilots With Different Average Annual Accumulated Flying Hours From Their Responses to the JSS, CFI and in Regard to the Three Coping Strategies

Survey/scores / Participant group		JSS	CFI	Task	Emotion	Avoidance
	Min	0.17	88	48	17	17
	Max	49.07	135	79	62	70
	M	17.92	117.12	65.47	34.97	43.17
	SD	10.86	10.00	6.81	10.03	10.48
Average annual accumulated flying 300 hours or less (*n* = 5, 6.5%)	Min	1.30	104	58	22	34
	Max	41.00	131	78	62	52
	M	23.73	119.60	69.00	37.00	42.60
	SD	15.73	9.92	7.62	14.95	6.99
Average annual accumulated flying 301–600 hours (*n* = 23, 29.9%)	Min	0.17	99	48	21	32
	Max	42.37	129	79	54	69
	M	16.21	115.48	65.17	35.09	44.57
	SD	10.85	8.11	7.19	10.05	9.83
Average annual accumulated flying 601–900 hours (*n* = 46, 59.7%)	Min	1.83	88	48	17	17
	Max	49.07	135	78	54	70
	M	17.87	117.24	65.07	35.09	42.07
	SD	9.99	10.90	6.39	9.68	11.11
Average annual accumulated flying more than 900 hours (*n* = 3, 3.9%)	Min	5.07	114	58	20	40
	Max	39.73	133	79	39	61
	M	22.21	123.67	68.00	29.00	50.33
	SD	17.33	9.50	10.54	9.54	10.50
Total (77)						

4.3.2.8.1 Comparison of stress levels between four groups of airline pilots with different average annual accumulated flying hours

The first part of H_6 focuses on whether pilots who fly more hours per year would show higher stress levels than pilots who fly fewer hours per year. A Kruskal–Wallis test was performed to test for a significant difference between pilot groups A, B, C and D in regard to stress levels. There was no statistically significant difference between these groups of pilots on their responses to the JSS: H (3) = 1.96, p = .58. Thus, pilots' stress levels were not associated with the number of hours they fly in a year, providing no support for this first part of H_6.

4.3.2.8.2 Comparison of cognitive flexibility levels between four groups of airline pilots with different average annual accumulated flying hours

The next part of this hypothesis relates to whether pilots with more accumulated flying hours in a year would have lower cognitive flexibility than pilots who fly fewer hours annually. A Kruskal–Wallis test did not find a statistically significant difference among the four pilot groups on their responses to the CFI questionnaire: H (3) = 3.21, p = .36. This suggest that pilots' cognitive flexibility levels were not affected by the number of hours they fly in a year, find no support for the second part of H_6.

4.3.2.8.3 Comparison of the degree to which task-oriented coping strategies are adopted, between four groups of airline pilots with different average annual accumulated flying hours

The third part of H_6 hypothesises that pilots with more accumulated annual flying hours would adopt task-oriented coping strategies to a lesser degree than those assigned to fly fewer hours in a year. Kruskal–Wallis test results show no statistically significant difference between pilots in the A, B, C and D groups regarding the degree to which they adopted task-oriented coping strategies: H (3) = 1.85, p = .61. Thus, the number of hours that pilots were assigned to fly in a year was not associated with the degree to which they adopted task-oriented coping strategies, with no support for the third part of H_6.

4.3.2.8.4 Comparison of the degree to which emotion-oriented coping strategies are adopted, between four groups of airline pilots with different average annual accumulated flying hours

The fourth part of H_6 assumes that pilots who fly more hours in a year would adopt emotion-oriented coping strategies to a greater degree than those who fly a smaller number of hours in a year. A Kruskal–Wallis test was performed to test whether the four groups of pilots would adopt emotion-oriented coping strategies differently. The result reveal no statistically significant difference between the four groups on their responses to the emotion-oriented coping dimension: H (3) = 1.17, p = .76. This suggests that the degree to which pilots adopted emotion-oriented coping strategies was not associated with the number of hours flown in a year; thus, there is no support this part of H_6.

4.3.2.8.5 Comparison of the degree to which avoidance-oriented coping strategies are adopted, between four groups of airline pilots with different average annual accumulated flying hours

The last test of H_6 involves an inspection of avoidance-oriented coping strategies; it was hypothesised that pilots who have higher workloads and more responsibility because they fly more hours per year would adopt avoidance-oriented coping strategies to a greater degree than pilots flying fewer hours annually. The last Kruskal–Wallis test of this hypothesis tested differences between the four groups of pilots in the degree to which they adopted avoidance-oriented coping strategies. There was no statistically significant difference between the four groups on their responses to the avoidance-oriented coping scores: H (3) = 2.13, p = .55. Therefore, it can be inferred that these pilots did not adopt avoidance-oriented coping strategies at a level according to the number of hours they flew in a year, providing no support for H_6.

4.3.2.8.6 H_6 testing summary

In summary, H_6 is not supported by the statistical analyses reported here: the four groups of pilots with different annual accumulated flying hours had very similar stress and cognitive flexibility levels and adopted the three coping strategies to a similar degree.

4.3.2.9 Testing H_7

***H_7** Stress levels are expected to decrease, and cognitive flexibility to increase, with increasing age. Older pilots are expected to adopt task-oriented coping strategies to a greater degree, whereas younger pilots are expected to adopt emotion- and avoidance-oriented coping strategies to a greater degree.*

Under this hypothesis, the aim was to address whether increasing age would decrease pilots' stress levels and increase their cognitive flexibility to readjust the degree to which they adopted different coping methods. The 77 pilots were classified into five age groups (see Table 4.12): (1) 25 years old or less ('young'; *n* = 4, 5.2%); (2) 26–35 years old ('under middle-aged'; *n* = 21, 27.3%); (3) 36–45 years old ('middle-aged'; *n* = 24, 31.2%); (4) 46–55 years old ('upper middle-aged'; *n* = 17, 22.1%); and (5) 55 and above ('older'; *n* = 11, 14.3%).

Table 4.12

Summary Scores for Pilots From Different Age Groups From Their Responses to the JSS, CFI and in Regard to the Three Coping Strategies

Survey/scores / Participant group		JSS	CFI	Task	Emotion	Avoidance
	Min	0.17	88	48	17	17
	Max	49.07	135	79	62	70
	M	17.92	117.12	65.47	34.97	43.17
	SD	10.86	10.00	6.81	10.03	10.48
25 years or less (*n* = 4, 5.2%)	Min	7.03	101	58	21	45
	Max	16.73	123	79	54	50
	M	11.19	112.75	67.75	39.50	47.00
	SD	4.53	9.03	8.96	17.06	2.16
26–35 years (*n* = 21, 27.3%)	Min	0.17	89	53	22	27
	Max	41.00	131	78	53	69
	M	17.12	113.86	65.10	35.43	44.33
	SD	8.93	11.86	6.61	9.40	10.71
36–45 years (*n* = 24, 31.2%)	Min	3.70	96	48	17	17
	Max	42.37	135	79	62	70
	M	20.66	119.12	65.92	35.71	44.58
	SD	12.54	9.75	8.66	11.35	12.69

46–55 years (*n* = 17, 22.1%)	Min	1.30	105	58	20	31
	Max	34.40	129	78	54	64
	M	17.22	120.18	65.12	31.47	42.00
	SD	9.28	6.50	4.89	7.47	7.30
More than 55 years (*n* = 11, 14.3%)	Min	1.83	88	55	22	24
	Max	49.07	125	73	50	59
	M	17.02	115.82	64.91	36.27	38.27
	SD	13.85	10.48	5.13	9.02	10.32
Total (77)						

4.3.2.9.1 Comparison of stress levels across different age groups of pilots

In the first instance, pilots' stress levels were investigated as it was hypothesised that these would decrease with increasing age. A Kruskal–Wallis test was executed to test for a difference in stress levels between pilots in different age groups. There was no statistically significant difference between the five groups on their responses to the JSS questionnaire: $H(4) = 2.93$, $p = .60$. Thus, stress levels did not differ between these groups; pilots of any age could experience either high or low levels of stress.

4.3.2.9.2 Comparison of cognitive flexibility levels across different age groups of pilots

This part of H_7 relates to whether increasing age would be associated with higher cognitive flexibility levels. Another Kruskal–Wallis test was performed to check for a significant difference between pilots in the five groups in their CFI mean scores. No such difference was found—$H(4) = 4.92$, $p = .23$—implying that pilots in different age groups had similar levels of cognitive flexibility and providing no support for H_7.

4.3.2.9.3 Comparison of the degree to which task-oriented coping strategies are adopted, across different age groups of pilots

This analysis aimed to determine whether older pilots would adopt task-oriented coping strategies to a greater degree than younger pilots. A Kruskal–Wallis test of the difference between pilots in the five groups in the degree they to which adopted task-oriented coping strategies as measured by their responses to the task-oriented coping dimension was not significant: H (4) = .66, p = .96. Thus, age did not influence the degree to which task-oriented coping strategies were adopted, finding no support for H_7.

4.3.2.9.4 Comparison of the degree to which emotion-oriented coping strategies are adopted, across different age groups of pilots

The investigation here examined whether younger pilots would adopt emotion-oriented coping strategies to a greater degree than older pilots. A Kruskal–Wallis test was applied to the five pilot age groups to test for a difference in their emotion-oriented coping mean scores. There was no significant difference—H (4) = 2.57, p = .63—showing that airline pilots in different age groups adopted emotion-oriented coping strategies to a similar degree when experiencing stress. This finding does not support this part of H_7.

4.3.2.9.5 Comparison of the degree to which avoidance-oriented coping strategies are adopted, across different age groups of pilots

The final investigation in relation to this hypothesis was designed to test whether younger pilots would adopt avoidance-oriented coping strategies to a greater degree than older pilots. The Kruskal–Wallis results show no evidence of a statistically significant difference in pilots' avoidance-oriented coping scores between the five age groups: H (4) = 5.19, p = .27. This shows pilots adopted avoidance-oriented coping strategies to the same degree regardless of age, failing to support the last part of H_7.

4.3.2.9.6 H_7 testing summary

In summary, age was not a dominant factor in pilots' stress or cognitive flexibility levels. Additionally, age was not associated with pilots' preferred type of coping strategy nor the degree to which they adopted a particular type, as verified by the statistical analyses.

4.3.2.10 Testing H_8

H_8 *The group of captains is expected to show lower stress levels and higher cognitive flexibility levels than the group of co-pilots. Furthermore, captains are expected to adopt task-oriented coping strategies to a greater degree, but emotion- and avoidance-oriented coping strategies to a lesser degree, than co-pilots.*

This final hypothesis tested in this chapter relates to whether the captains differed from the co-pilots in their stress and cognitive flexibility levels, and the degree to which they adopted different coping strategies. To evaluate this question, the 77 pilots were categorised into two groups (see Table 4.13): (1) captains (n = 35, 45.5%); and (2) co-pilots (n = 42, 54.5%). The parametric independent t-test was the most suitable statistical analysis to test the various aspects of H_8 as it was designed to investigate two independent groups. Furthermore, both the total sample size and each group's size exceeded 30 people, so the data could be assumed to be normally distributed (Hanna & Dempster, 2012).

Table 4.13

Summary Scores for Pilots With Different Rank From Their Responses to the JSS, CFI and in Regard to the Three Coping Strategies

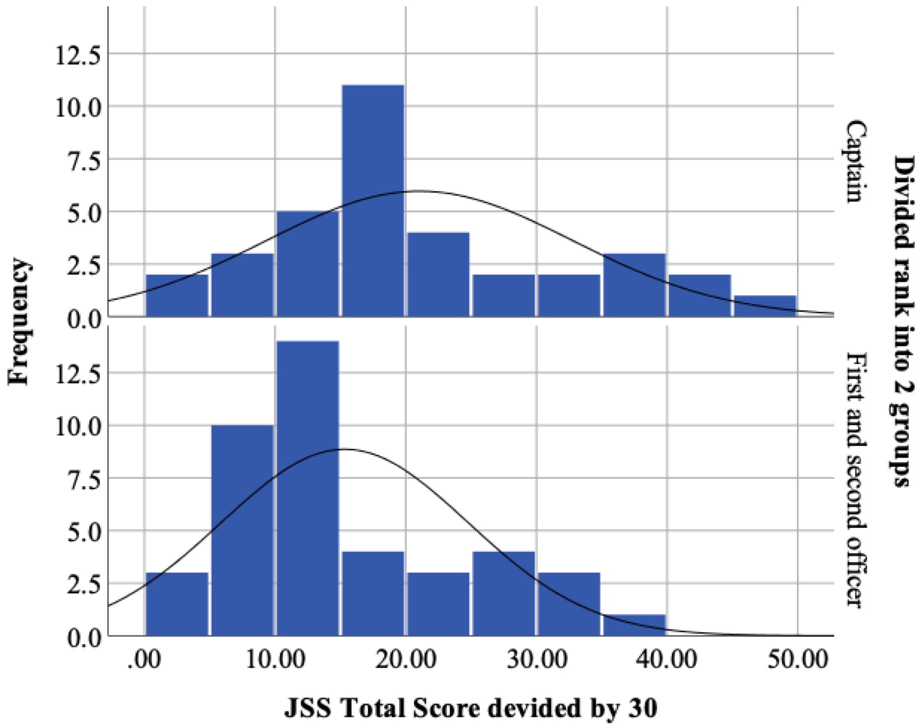
Survey/scores / **Participant group**		**JSS**	**CFI**	**Task**	**Emotion**	**Avoidance**
	Min	0.17	88	48	17	17
	Max	49.07	135	79	62	70
	M	17.92	117.12	65.47	34.97	43.17
	SD	10.86	10.00	6.81	10.03	10.48
Captains (n = 35, 45.5%)	Min	1.30	96	48	20	28
	Max	49.07	135	79	53	70
	M	21.05	118.66	63.77	34.66	44.57
	SD	11.71	8.38	6.68	8.81	9.44
Co-pilots (n = 42, 54.5%)	Min	0.17	88	53	17	17
	Max	39.50	132	79	62	69
	M	15.32	115.83	66.88	35.24	42.00
	SD	9.46	11.10	6.66	11.04	11.26
Total (77)						

4.3.2.10.1 Comparison of stress level between captains and co-pilots

The initial part of H_8 was intended to investigate the airline pilots' stress levels: it was hypothesised that the group of the captains would exhibit lower stress levels than the group of co-pilots. An independent *t*-test revealed a significant difference between the captains and the co-pilots in their responses to the JSS questionnaire (see Figure 4.21): t (75) = 2.37, p = .02. That is, the group of the captains showed higher stress levels than the group of co-pilots, which was the opposite to what was predicted.

Figure 4.21

Histograms of the JSS Scores for the Groups of Captains (Top) and Co-pilots (Bottom)

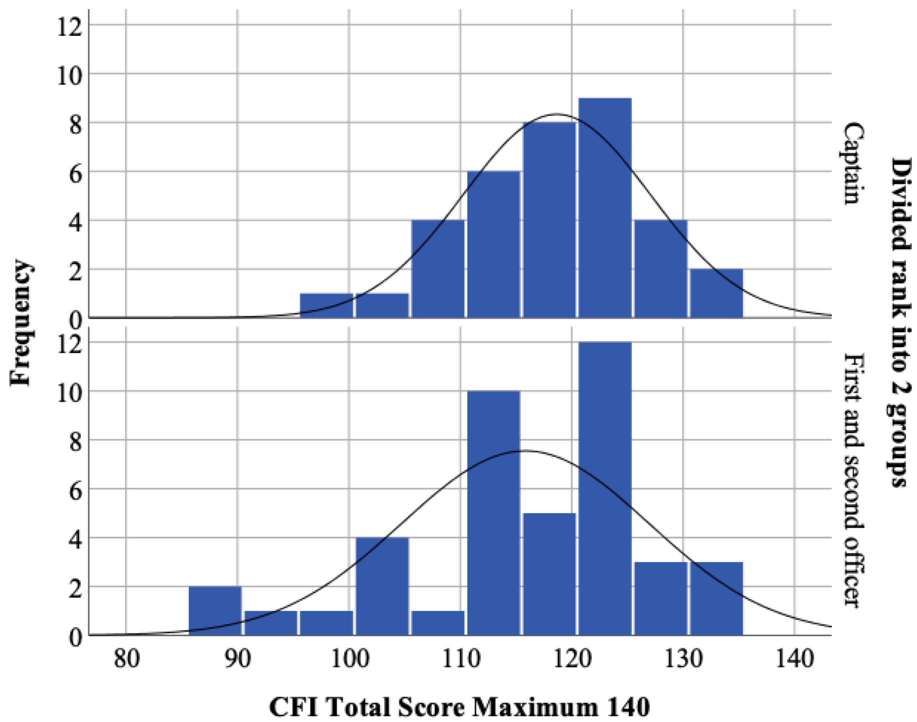


4.3.2.10.2 Comparison of cognitive flexibility levels between captains and co-pilots

This part of H_8 relates to whether the group of captains had higher cognitive flexibility levels than the group of co-pilots. An independent *t*-test was performed to test for a difference between the groups in their responses to the CFI questionnaire (see Figure 4.22): $t\,(75) = 1.24$, $p = .22$. The captains and the co-pilots showed a similar level of cognitive flexibility when experiencing stressors. Therefore, the statistical analysis results do not support this part of H_8.

Figure 4.22

Histograms of the CFI Scores for the Groups of Captains (Top) and Co-pilots (Bottom)

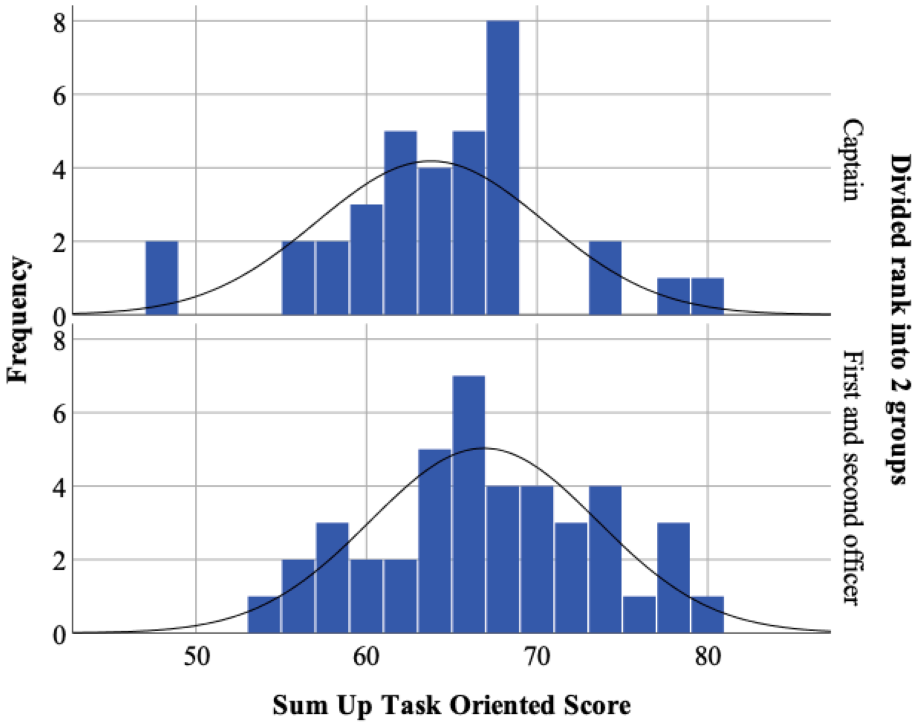


4.3.2.10.3 Comparison between captains and co-pilots in the degree to which they adopted task-oriented coping strategies

The third part of H_8 relates to whether the group of captains adopted task-oriented coping strategies to a greater degree than the group of co-pilots. An independent *t*-test revealed a significant difference between these groups in their responses to the task-oriented coping dimension (see Figure 4.23): $t\ (75) = –2.04$, $p = .045$. The group of co-pilots adopted task-oriented coping strategies to a greater degree than the group of captains. This is the opposite to what was expected.

Figure 4.23

Histograms of the CISS Task-oriented Coping Scores for the Groups of Captains (Top) and Co-pilots (Bottom)

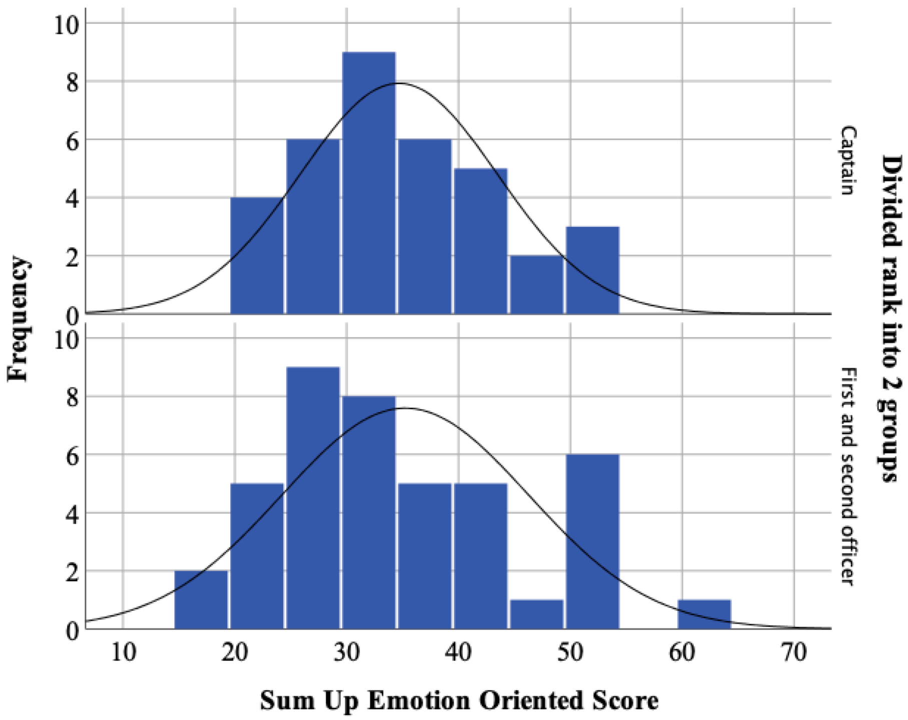


4.3.2.10.4 Comparison between captains and co-pilots in the degree to which they adopted emotion-oriented coping strategies

This analysis inspected the degree to which pilots and co-pilots adopted emotion-oriented coping strategies: it was hypothesised that the group of co-pilots would adopt this type of coping methods more than the group of captains. An independent *t*-test found no significant difference between the captain and co-pilot groups in their responses to the CISS emotion-oriented coping dimension (see Figure 4.24): t (75) = –.25, p = .80. Thus, the groups of captains and co-pilots adopted emotion-oriented coping strategies to a similar degree when experiencing stress.

Figure 4.24

Histograms of the CISS Emotion-oriented Coping Scores for the Groups of Captains (Top) and Co-pilots (Bottom)

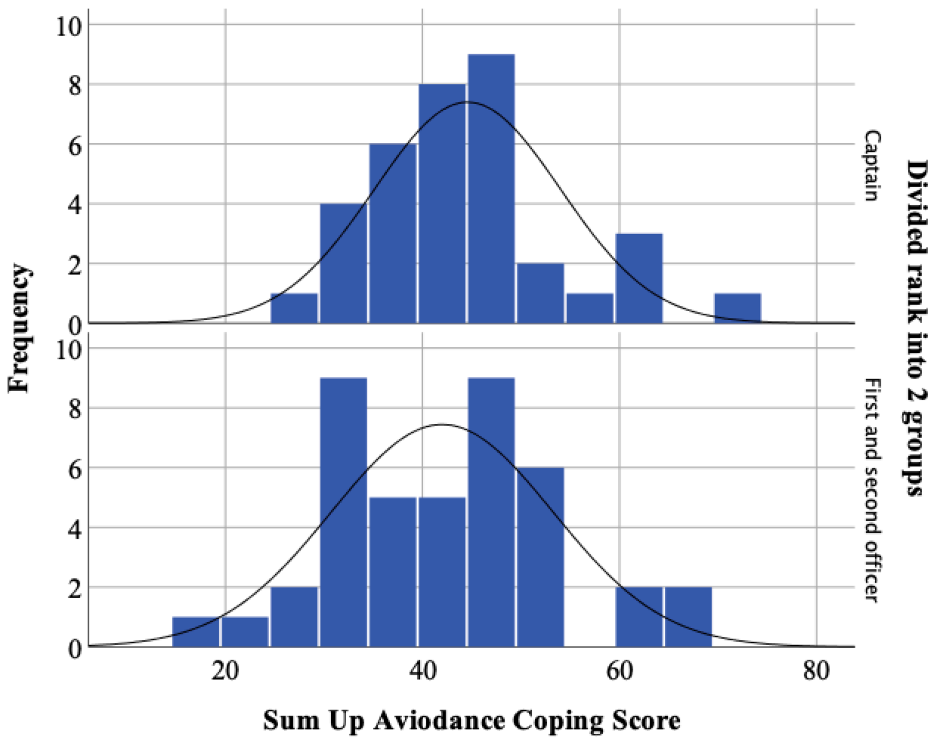


4.3.2.10.5 Comparison between captains and co-pilots in the degree to which they adopted avoidance-oriented coping strategies

The final analysis under H_8 aimed to identify whether the group of co-pilots adopted avoidance-oriented coping strategies to a greater degree than the group of captains. An independent *t*-test showed there was no statistically significant difference between the two groups in their responses to the CISS avoidance-oriented coping dimension (see Figure 4.25): $t\ (75) = -.25$, $p = .80$. Thus, the captain and co-pilot groups adopted avoidance-oriented coping strategies to a similar degree when they encountered stressors.

Figure 4.25

Histograms of the CISS Avoidance-oriented Coping Scores for the Groups of Captains (Top) and Co-pilots (Bottom)



4.3.2.10.6 H_8 testing summary

In relation to this final hypothesis, it can be concluded that there were some differences between the captains and co-pilots in their level of stress and the degree to which they adopted task-oriented coping strategies: the co-pilot group showed lower stress levels and higher task-oriented coping mean scores than the captain group. These results are the opposite to those expected under this hypothesis. However, there was no difference between the two groups in either their cognitive flexibility levels or the degree to which they adopted emotion- an avoidance-oriented coping strategies, regardless of whether they experienced low or high stress levels.

4.4 Discussion

The main objective of Study 1 was to investigate whether cognitive flexibility and task-oriented coping strategies reduce airline pilots' stress levels in the stressful environment of the aviation industry. The study outcomes were expected to provide guidance on how these two psychological resilience factors moderate professional pilots' stress in both direct and indirect ways so they can sustain their flying performance and maintain safety when flying. The results were also expected to provide insight for the researcher regarding any correlation between resilience factors and stress, and whether further research involving aviation students was warranted. The results show that there were direct and indirect correlations between cognitive flexibility and the three coping strategies, as well as with stress, as summarised in Table 4.14 and Figure 4.26. Moreover, it was found that the demographic variables of level of flying experience, age and rank did not alter these capabilities, as shown in Table 4.15.

Table 4.14

Summary of Correlations Between Factors for the Group of Airline Pilots

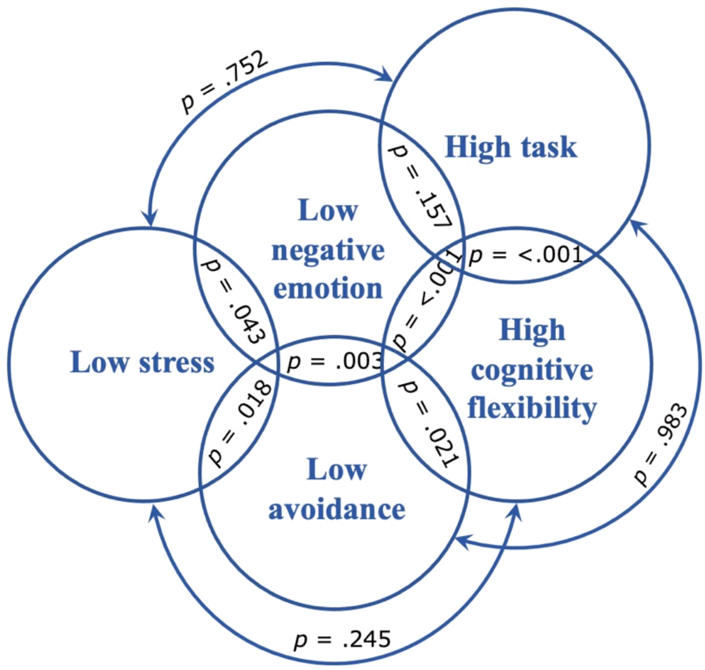
Factor pair	Correlation
Stress *v*. cognitive flexibility	No
Stress *v*. task-oriented coping strategies	No
Stress *v*. emotion-oriented coping strategies	Positive
Stress *v*. avoidance-oriented coping strategies	Positive
Cognitive flexibility *v*. task-oriented coping strategies	Positive
Cognitive flexibility *v*. emotion-oriented coping strategies	Negative
Cognitive flexibility *v*. avoidance-oriented coping strategies	Negative
Emotion-oriented coping strategies *v*. task-oriented coping strategies	Negative
Emotion-oriented coping strategies *v*. avoidance-oriented coping strategies	Positive
Task-oriented coping strategies *v*. avoidance-oriented coping strategies	No

4.4.1 Correlation Between Cognitive Flexibility, the Three Coping Strategies and Stress

The survey study involving the group of airline pilots revealed a direct relationship between cognitive flexibility and the three coping strategies, and an indirect relationship between stress and both cognitive flexibility and degree of adoption of task-oriented coping strategies. This means that cognitive flexibility levels can be used to directly predict pilots' adaptive coping style (task-oriented coping strategies) or maladaptive coping styles (emotion-oriented coping and avoidance-oriented coping strategies), but that only maladaptive coping styles can predict the level of stress. However, the relationship between stress and cognitive flexibility operated via these two factors' relationship with emotion- and avoidance-oriented coping strategies (see Figure 4.26). Thus, airline pilots who adopt negative emotion- and avoidance-oriented coping styles to a lesser degree appear to exhibit higher levels of cognitive flexibility and lower levels of stress, and vice versa. Thus, based on the statistical results for the group of airline pilots, it could be inferred that the relationship between cognitive flexibility and stress exists through a relationship with emotion- and avoidance-oriented coping strategies. Furthermore, the relationship between task-oriented coping strategies and stress exists through these two factors' relationship with emotion-oriented coping strategies, despite the lack of a direct relationship found between the degree of adoption of task-oriented coping strategies and the level of stress.

Figure 4.26

Identified Relationships Between Stress, Cognitive Flexibility and Three Coping Strategies for the Participating Airline Pilots



It is evident from the inferential statistics presented in this chapter that airline pilots' cognitive flexibility levels can influence their adaptive and maladaptive coping styles, as pilots with high cognitive flexibility adopted a higher degree of task-oriented coping but a lower degree of emotion and avoidance coping styles, and vice versa. Dennis and Vander Wal (2009) suggest that people with this capability can shift a course of thought or action according to the changing demands of the environmental information or situation. In addition, Baddeley (1998) and Stuss and Alexander (2000) point out that cognitive flexibility enables individuals to orient towards the future, demonstrate self-control and successfully perform goal-directed behaviours. Many authors (Campbell-Sills et al., 2006; Genet & Siemer, 2011; Gross, 2008; Southwick & Charney, 2012) argue that cognitive flexibility is one of the main components of a resilient individual. The current study findings support the hypothesis that pilots with greater cognitive flexibility are prone to greater resilience in that they can regulate their cognition in response to a changing environment.

Relative to highly cognitive pilots in this study, those with lower cognitive flexibility levels were more likely to engage in maladaptive coping styles, which include negative emotion and avoidance coping strategies. Such styles will provoke pilots into perceiving higher stress. Carver (2011) and Dubow and Rubinlicht (2011) suggest that negative emotions such as self-blame, blaming of others, anxiety and negative self-talk can lead to distance, escape or denial to avoid dealing with stressful scenarios (Kitano & Lewis, 2005; Penley et al., 2002). Roth and Cohen (1986) suggest that avoidance can interfere with an individual's ability to engage in appropriate action to eliminate stressors, which results in even more stress; thus, overuse of maladaptive avoidance coping strategies by pilots will generate a higher level of stress for them. However, positive emotion can broaden thought and coping repertoires in an encounter with hardship: Lazarus et al. (1980) point out that positive emotions can facilitate the use of effective task-oriented coping methods. They further explain that positive emotions help to preserve a tolerable internal state while one seeks constructive ways to reduce or eliminate stress.

This study did not find a direct relationship between stress and task-oriented coping, or between task- and avoidance-oriented coping. Thus, the practice of task-oriented coping strategies did not ensure that the airline pilots would perceive a lower degree of stress or would not make use of avoidance coping strategies. This phenomenon may have two bases. First, the pilot occupation is well known for its potentially high levels of work stress (Career Cast, 2013; Cranwell-Ward & Abbey, 2005) and thus the use of a task-oriented coping style alone may be inadequate to reduce stress. Second, minimal use of avoidance coping methods may complement the use of task-oriented coping methods in terms of alleviating stress and anxiety. Roth and Cohen (1986) point out that this type of coping strategy can allow a gradual recognition of threats if a person uses it to prevent themselves from becoming overwhelmed with stress.

In addition to correlations in the use of coping strategies, the weak negative relationship between emotion- and task-oriented coping can be considered valid even though the *p* value was not significant at the .05 level. This debate has several bases. First, significant relationships between cognitive flexibility, stress and use of emotion-oriented coping strategies were found in this study. Second, numerous researchers (Folkman, 1984; Lazarus, 1966; Maloney et al., 2014; Perez-Tejada et al., 2019) report relationships between these two factors that are either positive or negative. This might be interpreted to mean that positive emotions can influence one to adopt a higher degree of task-oriented coping while negative emotions may influence one to adopt a lower degree of task-oriented coping methods. Finally, Type II error (i.e., lack of statistical power due to small sample sizes) might be responsible for the high *p* value. Hanna and Dempster (2012) advise that an acceptable chance of statistical test error is .20 and a statistically significant difference might be detected with a larger sample size. For these reasons, it is reasonable to conclude that airline pilots who use less negative emotion-oriented coping strategies—such as blaming oneself and others, being upset or feeling anxious—are more likely to employ task-oriented coping strategies such as taking immediate corrective action to cope with a difficult situation.

The findings from this research study support the assumption that resilient pilots are those who display higher levels of cognitive flexibility and employ more task-oriented coping strategies when they experience stressful situations. These two traits are predicted to strengthen pilots' resilience when they experience an in-flight emergency. This assumption is built on the notion that an individual that shows high levels of cognitive flexibility can shift a course of thought or action according to the changing demands of the environmental information or situation. Thus, they will quickly recognise an unexpected event that threatens their lives. This ability also helps the individual generate multiple solutions to the problem and leads them to undertake problem-solving coping efforts. Therefore, pilots with these abilities have a higher chance of preventing a negative outcome from an unexpected event that could lead to a catastrophic accident and loss of lives.

4.4.2 The Role of Work Experience and Increased Workload

Research on resilience among professional health workers shows that the level of work experience is a predictor of the level of resilience for people in these occupations (Gillespie et al., 2009; Öksüz et al., 2019; Sánchez-Zaballos & Mosteiro-Díaz, 2020; Zheng et al., 2017). Several studies (Cheshire et al., 2017; Morgan & Craith, 2015; Sales et al., 2016) also find that the increased workload causes higher perceived stress, thus affecting people's resilience capability if they cannot manage their stress with a more effective approach. However, the findings in the current study suggest that a higher level of flying experience and increased workload due to flying more hours annually are not factors that modify, influence, or evolve airline pilots' resilience capability: no significant difference was found between groups of pilots differing in flying experience or workload in terms of their stress, cognitive flexibility, or preferred type of coping strategy. These results are summarised in Table 4.15.

Table 4.15

Summary of Hypothesis Testing Results for Airline Pilot Groups Classified According to Various Demographic Factors

Hypothesis summary						
Hypothesis		Stress	CF [a]	Task	Emotion	Avoidance
$\boldsymbol{H}_4$	Different total flying hours	p = .28	p = .09	p = .37	p = .35	p = .35
$\boldsymbol{H}_5$	Different annual accumulated flying hours	p = .58	p = .36	p = .61	p = .76	p = .55
$\boldsymbol{H}_6$	Different number of years of flying experience	p = .67	p = .12	2 groups differ p = .03	p = .48	p = .14
$\boldsymbol{H}_7$	Different age	p = .60	p = .23	p = .96	p = .63	p = .27
$\boldsymbol{H}_8$	Captains *v.* co-pilots	Captain higher p = .02	p = .22	Co-pilot higher p = .045	p = .80	p = .80

[a] Cognitive flexibility

Two groups of pilots classified according to years of flying experience differed significantly in the degree to which they adopted task-oriented coping strategies: pilots with 6–10 years of flying experience and those with 11–15 years of flying experience (Section 4.3.2.7.3). However, the researcher had reason to suspect that this result occurred by chance due to Type I error. First, because the total sample size was small, the result does not accurately predict or represent reality. Second, no difference was found in statistical tests based on airline pilots' experience measured by total flying hours (rather than years). Third, the mean task-oriented coping score for the group of pilots with less than five years of flying experience was also higher, yet statistical testing did not detect any significance between them. For these reasons, it was concluded that this significant observation was an anomaly, and that pilots with different years of flying experience had a similar level of task-oriented coping.

It is intriguing to see that pilots' stress levels, cognitive functioning and stress coping strategies are remarkably uniform regardless of a range of demographic factors. Since all professional pilots undergo similar training regimes, from ab initio flight training to type-specific training, and continue training on the job, it is expected that many pilots exhibit similar tendencies towards specific coping and resilience mechanisms. Their cognitive flexibility has also been nurtured through encounters with various types of hardship from limited funding for training, being in debt, fear of failure, bad weather, failing tests/exams, long hours at work, a highly stressful job with low payment and so on. To reach the professional career level, airline pilots must endure multi-tiered hardship and adversity of a type and level that is virtually identical for all of them. Thus, people who work in this occupation develop an extensive repertoire of behaviours by using adaptive coping methods that help them to maintain their performance in their flying career.

4.4.3 The Role of Age

The analyses in this study revealed no significant differences between airline pilots in five age groups (ranging from less than 25 to more than 55 years) in terms of their stress and cognitive flexibility levels, or the degree to which they adopted particular coping strategies. The result from this study supported that age did not influence the level of resilience in the group of airline pilots. Similar results were found in studies by Beutel et al. (2009) and Lamond et al. (2008) who examined the resilience trait of women across different age groups. Both studies found age did not influence the level of resilience in women (Beutel et al., 2009; Lamond et al., 2008). Gillespie et al. (2009) also found that age did not have an impact on resilience traits of nurses in the Operating Room. Even though some studies (Aldwin & Revenson, 1985; Blanchard-Fields et al., 1991; Brudek et al., 2019; Irion & Blanchard-Fields, 1987; Kruczek et al., 2020) suggested that younger adults adopted more emotion and avoidance coping strategies than adults with older age but adopted the same level of task-oriented coping as older adults. However, McCrae (1982) suggests that the coping strategies adopted by younger or older adults are largely dependent on what type of stressors they encounter. If a stressor with which an individual has to deal seems to be controllable then task-oriented coping efforts will be made, whereas if the stressor seems uncontrollable then avoidance-oriented coping is more likely to be the choice. Accordingly, this study considers that because airline pilots in different age groups encounter similar types of stressors in the flying environment, it is not surprising that those of different ages would adopt the three coping strategies to a similar degree.

The inferential statistics show that younger airline pilots did not have higher stress levels than older airline pilots. This could be because all pilots who achieve a professional career in flying have to go through a training process that develops their attitude and mindset to correctly respond to different types of stressors in similar circumstances. The tough training process and comprehensive licence requirements enhance their cognitive flexibility and enable them to tolerate physical and psychological hardships in an effective and positive manner. The experiences gained throughout flight training are considered 'stress inoculation'. Meichenbaum (2017) and Stetz et al. (2007) argue that controlled exposure to stress-related cues is a key feature of resilience training. For this reason, pilots in all age groups who have already experienced similar types of stressors are more likely to overcome future hardships or adverse events in their flying careers.

Additionally, the statistical analyses in this chapter revealed no differences among the five age groups in their preferred coping strategies. This may be because pilots of different ages do not specifically use a certain coping method but engage in diverse coping strategies when coping with different types of stressors. Aldwin (2007) finds that people of different ages adopt different coping strategies. Therefore, the focus should be on coping efficacy, which indicates whether an individual uses a coping strategy that is effective in a given situation. Nevertheless, testing of H_1–H_3 shows that pilots with greater cognitive flexibility adopted higher task-oriented coping, lower negative emotion-oriented coping, and lower avoidance-oriented coping than pilots with lower cognitive flexibility, which is a sign of higher resilience.

4.4.4 Effect of Position

When comparing airline pilots by their rank, this study identified that the group of captains displayed higher stress levels and adopted a lower degree of task-oriented coping strategies than the group of co-pilots. However, there were no differences between these groups in their cognitive flexibility levels or the degree to which they adopted emotion- and avoidance-oriented coping strategies.

The literature review on the keywords 'captains and co-pilots' stress', 'captain and co-pilots' cognitive flexibility', and 'captain and co-pilots' coping strategies', highlighted a dearth of research found in this field. Nevertheless, an interview study by Ragnarsdóttir (2018) discovered that although captains and co-pilots reported that they worked collaboratively inside the cockpit and had similar workloads, the captain position is charged with more responsibility and authority as they are the person who makes the final decision regarding any major issues in flight. In the investigation involving captains and co-pilots in this study, 8 of the 12 pilots with high stress levels were captains. Therefore, it is logical to conclude that because of the sense of higher responsibility relating to the role of the captain, pilots in this position generally feel greater levels of stress than their subordinates.

The analysis in this study identified a weak, insignificant difference in mean cognitive flexibility between the groups of captains and co-pilots, with captains having higher scores than co-pilots. This result weakly supports the idea that captains have higher cognitive flexibility than co-pilots, however, the finding does not support that captain with higher cognitive flexibility will exhibit lower stress levels. It appears that cognitive flexibility may have a moderating role when captains experience a higher level of stress than co-pilots. This might be explained by the results from a study by

Britt et al. (1995) on soldiers, which revealed that increased responsibility and commitment can promote psychological and physical health if an individual believes that they possess the ability to perform a given task. The findings by Britt et al. (1995) suggest that when a stressor is perceived as a challenge (during the primary appraisal), this enhances positive emotions, which increases cognitive flexibility and lowers stress levels. This process can help a person to perform better. To become a captain, a pilot has already demonstrated a higher capacity to control the aircraft via their technical and non-technical skills. Thus, they have committed to high performance of stressful tasks that come with the higher position. Therefore, even though the stress relating to higher responsibility appeared to be greater in the group of captains, their high level of cognitive flexibility may assist in strengthening their performance when working in a high-risk environment.

Surprisingly, this study found that the group of co-pilots appeared to engage in more task-oriented coping strategies than the group of captains. However, there was no significant difference between them in engagement of maladaptive coping styles. This may be because Type I error led to rejection of the null hypothesis when actually, there was no difference between the groups under study. This inference is made because the captains were not found to use a higher degree of negative emotion- and avoidance-oriented coping strategies than the co-pilots. In particular, as it was found that captains showed higher stress levels than co-pilots it was assumed they would adopt maladaptive coping methods to a higher degree, but they did not. For these reasons, this research concludes there is no difference in how captains and co-pilots engage in the three coping strategies.

4.5 Chapter Summary

From the findings in this chapter, it can be concluded that professional airline pilots who exhibit a high level of cognitive flexibility adopt a more adaptive coping style—termed task-oriented coping in this thesis—and engage less in maladaptive coping styles; that is, negative emotion and avoidance coping strategies. However, high cognitive flexibility pilots who employ task-oriented coping strategies do not always have lower levels of stress. This is likely because of the nature of the job itself, where the pilot always has to deal with time pressure and a high-risk environment. The findings also suggest that engagement of emotion-oriented coping can lead to adoption of more task-oriented coping if the emotion is positive, and more avoidance-oriented coping if it is negative. In addition, factors including level of flying experience, age and workload do not influence pilots' cognitive flexibility levels or the degree to which they engage in any particular coping method.

CHAPTER 5: STUDY 2—AVIATION STUDENTS

5.1 Purpose

The purpose of this study was to investigate interrelationships between stress, cognitive flexibility, task-oriented coping strategies, and individual resilience in a group of aviation students and compare these between the groups of EFS and NFS. Additionally, this study aimed to investigate whether flying experience strengthens these resilience capabilities. The findings from this study were expected to provide evidence that cognitive flexibility and task-oriented coping strategies are two of many resilience factors that support aviation students to strengthen their resilience capability and improve their ability to work under pressure and in a high-risk environment such as the aviation industry, with safer outcomes. This additional study was intended to reveal the point in a pilot's early career at which resilience capabilities begin to emerge. The operation of resilience was examined as a function of the level of flying experience.

5.2 Method

5.2.1 Design Overview

Study 2 was designed to complement Study 1 by observing resilience capability in different populations. In Study 1, airline pilots' cognitive flexibility levels and their preferred coping method that influences their stress levels were identified and direct and indirect relationships between these factors revealed. Study 2 investigated whether aviation students differ in their cognitive flexibility levels and preferred type of coping method when they experience stress, to identify when these capabilities begin to be strengthened. Accordingly, the objective of this study was to gather a set of data on stress, cognitive flexibility, and preferred type of coping strategy from pilot trainees (those prior to attaining their commercial pilot licence ['pre-CPL'] and those that had already attained a commercial pilot licence ['post-CPL']) and aviation students with no flying experience.

This survey study adopted the same self-report questionnaires as used in Study 1 (the CFI [Dennis & Vander Wal, 2009] and CISS [Endler & Parker, 1990, 1999]) to measure students' resilience capability in response to stress. However, to enquire about the students' stress experience, the PSS (Cohen & Williamson, 1988; Cohen et al., 1983) was adopted instead of the JSS. This is because the latter was designed to examine stressors experienced by employees in the workplace, which is not applicable to a group of full-time students in flight training or university. The PSS questionnaire was designed to inspect general situations causing stress that an individual may have experienced in the previous month. Thus, the PSS's questions are more suitable for the group of full-time students than are the JSS's questions. The survey was designed to gather information on nine demographic factors to identify students' flying experience levels and whether these variables may have affected their resilience ability.

5.2.2 Participants

The dataset for Study 2 was collected from a total of 123 aviation students. The responses mainly came from two groups of people: (1) pilot trainees currently in flight training ('Experienced in Flying Students'[12] or EFS) having passed at least their first solo check (*n* = 73, 59.3%); and (2) university students currently studying in the USQ aviation program ('Non-experience in Flying Students' or NFS) (*n* = 50, 40.7%). The age range of participants in Study 2 was 17–34 years with a mean of 21 years. The largest number of aviation students (*n* = 110, 89.4%) was aged 25 years or less ('young students'), followed by the group of students (*n* = 13, 10.6%) aged more than 25 years ('older students'). There were 94 (76.4%) male and 29 (23.6%) female students. The majority of students (*n* = 84, 68.3%) were completing their flight training as a degree requirement (see Table 5.1).

Among the group of 73 EFSs currently enrolled in flight training, their total flight hours at the time of the survey ranged between 14 and 430 hours. This group was subdivided into two main subgroups: the post-CPL group and the pre-CPL group.

[12] The 'experienced in flying students' data were collected from (1) the group of students having completing their flight training as a degree requirement and (2) the group of students having to complete the flight training only.

The reason for not classifying the students into recreational pilot licence (RPL) or private pilot licence (PPL) groups is that some did not report that they had achieved these licences as not all flying schools record such milestones. Therefore, for consistency in data analysis, these students were divided into the groups specified above.

Table 5.1

Demographic Characteristics of Participating Aviation Students

Demographic features	Frequency	%
(1) Age (*n* = 123)		
25 years or less	110	89.4
Over 25 years	13	10.6
(2) Gender (*n* = 123)		
Male	94	76.4
Female	29	23.6
(3) Completed flight training as a degree requirement (*n* = 123)		
Yes	84	68.3
No	39	31.7
(4) Completed first solo (*n* = 123)		
EFS	73	59.3
NFS	50	40.7
(5) Completed commercial pilot licence (*n* = 73)		
Yes	27	37.0
No	46	63.0
(6) Failed major tests/exams (*n* = 73)		
Yes	34	46.6
No	39	53.4

Of the EFS group, 27 students (37.0%) had achieved their CPL, and had total flying time ranging from 146.1 hours to 295.0 hours, with a mean of 164.81 hours. The other 46 students (63.0%) had passed their first solo check and had total flying time ranging from 9.0 hours to 22.5 hours, with a mean of 13.84 hours. Among the EFS group, 34 (46.6%) had failed some major tests/exams (the ‘failing’ group) with

1–7 failed assessments, and a mean of 1.94. The other 39 student pilots (53.4%) had not failed any major exams/tests (the 'non-failing' group).

5.2.3 Materials

The survey was constructed on the LimeSurvey platform and designed to contain four sections with four clear separate headings: (1) demographic information; (2) PSS questionnaire; (3) CFI questionnaire; and (4) CISS questionnaire.

5.2.3.1 Demographic Information

This section asked nine questions aiming to collect information about (1) age, (2) gender, (3) whether the student had completed their flight training as a degree requirement, (4) whether the student had flown their first solo, (5) whether the student had flown their first area solo, (6) whether the student had achieved their RPL, (7) whether the student had achieved their PPL; (8) whether the student had achieved their CPL; and (9) whether the student had failed any major exams/tests relating to flight training.

5.2.3.2 Perceived Stress Scale (PSS)

Because of unsuitability of the JSS for use with full-time students as mentioned above, multiple alternative questionnaires were reviewed to identify one in which questions related to a generic situation that caused stress, rather than any specific situation; and that was widely used in research studies. The PSS questionnaire met these criteria and was selected for this study. The supervisory team assisted in reviewing the questions and was satisfied with the survey before the study proceeded.

The PSS is one of the most widely used psychological instruments in many research disciplines (Blouin et al., 2014; Chen et al., 2020; Kruczek et al., 2020; Lalić et al., 2007; Swaminathan et al., 2016) to measure the perception of stress. The scale was developed by Cohen et al. (1983) to measure 'the degree to which situations in one's life are appraised as stressful' (p. 385). It was designed to tap into 'how unpredictable, uncontrollable and overloading in a situation respondents find stressful in their lives in the past month'. The questionnaire does not attach an individual appraisal to any particular situation. Instead, the scale is responsive to the non-occurrence of events as well as ongoing life circumstances. Furthermore, the questionnaire was designed for use in community samples of people with at least a junior high school education. Therefore, items are easily interpreted and relatively general to any subpopulation groups (i.e., workers or students) and in a large variety of contexts (i.e., workplace, scientific and clinical studies).

The PSS-10 was selected for this study because it takes less time to administer than other questionnaires and because of simplicity in its scoring process. The scale was originally developed as a 14-item form (PSS-14) (Cohen et al., 1983) before it was improved to shorter versions as the PSS-10 and PSS-4 (Cohen & Williamson, 1988). In Study 2, the PSS-10 was adopted as it has been confirmed by multiple studies (Lesage et al., 2012; Mitchell et al., 2008, Reis et al., 2010; Remor, 2006) to show good psychometric properties, reliability, validity, and internal consistency; thus, these researchers recommend use of this scale in a research setting.

5.2.3.2.1 PSS scoring process

The PSS-10 contains 10 questions designed using a five-point Likert scale as a response format with the following options: 0 *never*, 1 *almost never*, 2 *sometimes*, 3 *fairly often* and 4 *very often* (see Figure 5.1). It is used to assess the degree of stress in a situation that an individual has found stressful in the previous month (the full list of questions is presented in Appendix 5). Each question can have a minimum score of 0 points and maximum of 4 points; therefore, the total PSS-10 score ranges from 0 to 40. Cohen (1994) advise that before proceeding to calculating the total PSS score by summing scores across all scale items, items 4, 5, 7 and 8 must be reverse scored (i.e., 0 = 4, 1 = 3, 2 = 2, 3 = 1, 4 = 0).

Figure 5.1

Example PSS Sample Questions

10-items Perceived Stress Scale

*

Please choose the appropriate response for each item:

	0 = Never	1 = Almost Never	2 = Sometimes	3 = Fairly Often	4 = Very Often
In the last month, how often have you been upset because of something that happened unexpectedly?	○	○	○	○	○
In the last month, how often have you felt that you were unable to control the important things in your life?	○	○	○	○	○

Note. Adapted from 'Perceived Stress Scale', by S. Cohen, 1994 (https://www.mindgarden.com/documents/PerceivedStressScale.pdf). Copyright 1994 by Sheldon Cohen.

5.2.3.2.2 Interpretation of PSS scoring

Cohen et al. (1983) show that a higher total PSS score indicates a higher level of stress, whereas a lower total PSS score indicates a lower level of stress. The original authors of the PSS (Cohen et al., 1983) and Cohen & Williamson (1988), as well as Klein et al. (2016) and Remor (2006) advise that the PSS-10 does not provide 'standard cut-off scores' because it was not designed as a diagnostic instrument; therefore, there are no cut-off scores for the classification of 'high', 'medium' and 'low' stress. It is only possible to compare stress levels among the people in a researcher's sample. However, cut-off scores are beneficial for identifying whether participants had high, medium, or low stress scores compared with the average people to inform researchers and readers of the characteristics of a group under study. Therefore, the researcher in the current study used PSS cut-off scores provided by the State of New Hampshire Department of Administrative Services (2014) to assess stress levels of their employees. They add as a disclaimer that, 'the scores on the following self-assessment do not reflect any particular diagnosis or course of treatment. They are meant as a tool to help assess your level of stress' (p. 3). The same cut-off scores were also utilised in research on first-year medical undergraduate students in India (Swaminathan et al., 2016)—a very similar population in a university level to the group in the current study.

Given their use in at least two contexts of which the researcher is aware, these cut-off scores were considered reasonable for applying to the descriptive statistics in this study to enable observation of trends in the data Their values are 0–13 for low, 14–26 for moderate and 27–40 for high perceived stress. As these cut-off scores were used in another study as well as in the employee assistance program.

5.2.4 Procedure

The survey data were collected via the LimeSurvey platform as utilised in Study 1, for the reasons explained in Section 4.2.4: LimeSurvey is free of charge for USQ staff, students, and researchers, and accommodates multiple flexibilities of experiments for research purposes. Therefore, LimeSurvey was a suitable data collection channel for use in this study.

As explained in more detail in Section 4.2.4, use of the CISS questionnaire for research purposes required permission from MHS (Licence Agreements and Permission to Copy are attached in Appendix 3). However, use of the PSS by students or researchers engaged in non-profit research did not require permission (public permission for its use is provided in Appendix 6). After the researcher had ensured that permission for use of all questionnaires was in hand, an Amendment Form was submitted presenting the updated set of questionnaires to the USQ HRE Committee for ethical review and approval for the data collection for Study 2.

The amended ethics approval was granted under the same HRE ID as Study 1 (H19REA301). Because of the licence agreement with MHS, the survey could not be disseminated in the public domain. Instead, invitations to complete the survey were sent out via e-mail to multiple flying schools and universities in Australia that offer an aviation program, asking them to disseminate the request to complete the survey to their students as well as inviting students through personal contact. Any students interested in completing the survey sent a request to the researcher via e-mail asking for the link to access the survey. No remuneration was offered as an incentive to participate in the survey. This survey was opened from 1 March 2021 to 31 May 2021.

5.2.5 Hypotheses

Study 2 was informed by the research findings of Study 1 and aimed to investigate the relationships between stress and cognitive flexibility levels, and preferred coping methods for the group of aviation students when experiencing stress. Furthermore, this study aimed to investigate if flight training would extend these resilience factors and which variables would affect these capabilities. The hypotheses are:

$\boldsymbol{H_1}$ For aviation students who show lower stress levels, a negative correlation is predicted between their cognitive flexibility and preference for task-oriented coping strategies. For aviation students who show higher stress levels, a positive correlation is predicted between the preference for emotion- and avoidance-oriented coping strategies.

$\boldsymbol{H_2}$ Aviation students who show higher cognitive flexibility levels are predicted to prefer adopting task-oriented coping strategies to a higher extent but emotion- and avoidance-oriented coping strategies to a lower extent relative to aviation students who show lower cognitive flexibility.

$\boldsymbol{H_3}$ Aviation students who prefer emotion-oriented coping strategies to a higher extent are predicted to prefer task-oriented coping strategies to a lesser extent and avoidance-oriented coping strategies to a greater extent; whereas aviation students who prefer task-oriented coping strategies to a higher extent are predicted to prefer avoidance-oriented coping strategies to a lower extent.

$\boldsymbol{H_4}$ The EFS group is hypothesised to show lower stress levels and higher cognitive flexibility levels and prefer task-oriented coping strategies to a greater extent and emotion- and avoidance-oriented coping strategies to a lesser extent, than the NFS group.

$\boldsymbol{H_5}$ Aviation students' stress levels are expected to decrease, and cognitive flexibility levels to increase, with older age. Also, older students are predicted to prefer task-oriented coping strategies to a greater extent and emotion- and avoidance-oriented coping strategies to a lesser extent than younger students.

$\boldsymbol{H_6}$ Male and female aviation students are expected to show the same cognitive flexibility levels and a similar preference for avoidance-oriented coping strategies. However, males are predicted to show lower stress levels and to prefer task-oriented coping strategies to a higher degree than females, who are predicted to show higher stress levels and prefer emotion-oriented coping strategies to a greater extent.

$\boldsymbol{H_7}$ In the EFS group, student pilots who have completed flight training as a degree requirement are expected to show higher stress levels than those who have not. However, EFS group cognitive flexibility levels and preference for the three coping strategies is expected to be the same as those of the NFS group.

$\boldsymbol{H_8}$ In the EFS group, CPL holders are expected to show lower stress levels and higher cognitive flexibility levels, and to prefer task-oriented coping strategies to a greater extent, and emotion- and avoidance-oriented coping strategies to a lesser extent, than students who have not attained their CPL.

$\boldsymbol{H_9}$ Among the EFS pilot group, those with more total flying hours are expected to show lower stress levels and higher cognitive flexibility levels, and to prefer task-oriented coping strategies to a greater extent and emotion- and avoidance-oriented coping strategies to a lesser extent, than those with fewer total flying hours.

$\boldsymbol{H_{10}}$ Among the EFS pilot group, those who have failed major tests/exams are expected to show higher stress scores and lower cognitive flexibility levels, and to prefer task-oriented coping strategies to a lesser extent and emotion- and avoidance-oriented coping strategies to a greater extent, than the group who have never failed any tests/exams.

Accordingly, this survey focused on understanding how this study group's stress levels, cognitive flexibility levels and preferred coping methods would differ according to a set of diverse variables.

5.3 Results

This results section begins with an overview summary of the aviation students' responses to all three questionnaires. The information is presented in the form of descriptive statistics to show general trends in the dataset from this cohort. Later in this section, the hypotheses are tested using inferential statistical tests to test for statistical significance in comparisons. The suitable statistical methods for each hypothesis are discussed so that the reader is informed of what can be expected for the statistical analyses in Study 2.

5.3.1 Descriptive Statistics Summary for Each Questionnaire

The descriptive statistics in this section present response score summaries for the PSS, the CFI and the CISS from the group of aviation students, to provide details on the overall characteristics of the focus group. The descriptive statistics are also presented separately for the two main groups of EFS and NFS to compare their scores. By categorising these students' scores, the researcher was able to identify whether this group shows similar characteristics to average people, or whether they showed special attributes different from the average person.

5.3.1.1 Overall Response Results for the PSS Questionnaire

The total PSS score ranges from 0 to 40, with a higher score indicating higher perceived stress. Cut-off scores derived from the State of New Hampshire Employee Assistance Program were applied here: 0–13 (considered low stress), 14–26 (considered moderate stress) and 27–40 (considered high perceived stress).

PSS scores for the 123 aviation students completing the questionnaire ranged from 0 to 32, with a mean score of 14.94 (SD = 6.09). Only five students (4.1%) had high stress scores, and their scores ranged from 27 to 32, with a mean of 29.40 (SD = 2.07). A total of 64 students (52.0%) obtained average stress scores, ranging from 14 to 26, with a mean of 18.38 (SD = 3.36); and 54 (43.9%) had low stress scores: range 0–13; mean 9.54 (SD = 2.81).

The 123 students were separated into groups of EFS (*n* = 73) and NFS (*n* = 50). The EFS group had stress scores ranging from 0 to 32, with a mean of 13.86 (*SD* = 5.76). Only one student pilot (1.4%) had a high stress score, of 32. Most (*n* = 37, 50.7%) had average scores, in the range 14–26 with a mean of 17.92 (*SD* = 3.05). There were 35 student pilots (47.9%) with low stress scores of 0–13: mean 9.06 (*SD* = 3.01).

Among the 50 NFS, stress scores ranged from 5 to 31, with a mean of 16.52 (*SD* = 6.27). Four students (8.0%) obtained high stress scores ranging from 27 to 31, with a mean of 28.75 (*SD* = 1.71). The majority of students (*n* = 27, 54.0%) had average stress scores: 14–26, with a mean of 19.00 (*SD* = 3.70). Nineteen students (38.0%) had low stress scores, ranging from 5–13, with a mean of 10.42 (*SD* = 2.22). A descriptive statistics summary for the PSS is provided in Table 5.2.

Table 5.2

Descriptive Statistics for the PSS Based on the Responses of Aviation Students

Group of participants	%	Possible range of scores	Observed range of scores	*M*	*SD*
All aviation students					
Total participants (*n* = 123)	100	0–40	0–32	14.94	6.09
High (*n* = 5)	4.1	27–40	27–32	29.40	2.07
Average (*n* = 64)	52.0	14–26	14–26	18.38	3.36
Low (*n* = 54)	43.9	0–13	0–13	9.54	2.81
EFS group					
Total participants (*n* = 73)	100	0–40	0–32	13.86	5.76
High (*n* = 1)	1.4	27–40	32	32	-
Average (*n* = 37)	50.7	14–26	14–26	17.92	3.05
Low (*n* = 35)	47.9	0–13	0–13	9.06	3.01
NFS group					
Total participants (*n* = 50)	100	0–40	5–31	16.52	6.27
High (*n* = 4)	8.0	27–40	27–31	28.75	1.71
Average (*n* = 27)	54.0	14–26	14–26	19.00	3.70
Low (*n* = 19)	38.0	0–13	5–13	10.42	2.22

5.3.1.2 Overall Response Results for the CFI Questionnaire

The CFI standard scores range from 20 to 140. Individuals with lower CFI scores show greater cognitive rigidity, whereas individuals with higher CFI scores show greater cognitive flexibility. No standard cut-off scores are provided by the CFI scale developers. Therefore, the descriptive statistics present only the overall range of response scores for the whole group and for the separate groups of EFS and NFS.

For the 123 aviation students completing this survey, their scores ranged from 77 to 139, with a mean of 110.07 (*SD* = 11.58). The 73 students in the EFS group (59.3%) had CFI scores ranging from 77 to 139, with a mean of 112.74 (*SD* = 10.98); and the 50 students in the NFS group (40.7%) had scores ranging from 77 to128, with a mean of 106.16 (*SD* = 11.44). The CFI descriptive statistics are summarised in Table 5.3.

Table 5.3

Descriptive Statistics for the CFI Based on the Responses of Aviation Students

Group of participants	%	Possible range of scores	Observed range of scores	*M*	*SD*
Total participants (*n* = 123)	100	20–140	77–139	110.07	11.58
EFS group (*n* = 73)	59.3	20–140	77–139	112.74	10.98
NFS group (*n* = 50)	40.7	20–140	77–128	106.16	11.44

5.3.1.3 Overall Response Results for the CISS Questionnaire

Full details of the questionnaire and score interpretation relating to CISS raw scores, T-scores and cut-off scores for males and females are presented in Sections 4.2.3.4 and 4.3.1.4.

The CISS questionnaire contains 48 questions relating to three main scales: the task-, emotion- and avoidance-oriented coping dimensions. Each scale contains 16 questions, and each has scores ranging from 16 to 80. Individuals with higher test scores in any coping dimension show a greater preference for that specific type of coping strategy. The CISS *T*-score cut-off points were set at 61 or above for a high score, 40–60 for an average score and 39 or below for a low score. The conversion of cut-off *T*-scores to raw scores for males and females is shown in Table 5.4.

Table 5.4

Conversion of CISS T-Scores to Raw Scores

***T*-scores**	**Task-oriented**		**Emotion-oriented**		**Avoidance-oriented**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
61 and above	70 and above	68 and above	52 and above	55 and above	49 and above	56 and above
40 – 60	49 – 69	50 – 67	28 – 51	31 – 54	29 – 48	34 – 55
39 and below	48 and below	49 and below	27 and below	30 and below	28 and below	33 and below

5.3.1.3.1 Task-oriented coping dimension descriptive statistics

Among the 123 aviation students completing the CISS task-oriented coping questionnaire, their *T*-scores ranged from 25 to 72, with a mean of 53.60 (*SD* = 8.93). There were 26 students (21.1%) who had high task-oriented coping scores, and their *T*-scores ranged from 61 to 72, with a mean of 65.65 (*SD* = 3.70). The majority of the aviation students (*n* = 90, 73.2%) had average scores, and their *T*-scores ranged from 40 to 60, with a mean of 51.59 (*SD* = 5.09). Only a few of the aviation students (*n* = 7, 5.7%) had low scores, of 25–35, with a mean of 32.14 (*SD* = 3.39).

The 73 students in the EFS group had *T*-scores of 34 to 72 for the task-oriented coping dimension, with a mean of 56.48 (*SD* = 8.03). There were 23 student pilots (31.5%) with high *T*-scores ranging from 61 to 72, with a mean of 65.70 (*SD* = 3.77). The majority of student pilots (*n* = 49, 67.1%) had *T*-scores of 40–60, and a mean of 52.61 (*SD* = 4.86). Only one student pilot (1.4%) had a low *T*-score, of 34.

The statistics for the 50 students in the NFS group show that for the task-oriented coping questions, their *T*-scores ranged from 25 to 68, with a mean of 57.86 (*SD* = 8.50). Only three students (6.0%) had high *T*-scores, of 61 to 68 with a mean of

65.33 (*SD* = 3.79). The majority of students (*n* = 41, 82.0%) had average *T*-scores of 41–60; mean 50.37 (*SD* = 5.14). Six students (12.0%) had low task *T*-scores ranging from 25 to 35, with a mean of 31.83 (*SD* = 3.60). The descriptive statistics for the task-oriented coping dimension are summarised in Table 5.5.

Table 5.5

Descriptive Statistics for the CISS on the Task-oriented Coping Dimension

Group of participants	%	Possible range of *T*-scores	Observed range of *T*-scores	*M*	*SD*
All aviation students					
Total participants (*n* = 123)	100	25–75	25–72	53.60	8.93
High (*n* = 26)	21.1	61–75	61–72	65.65	3.70
Average (*n* = 90)	73.2	40–60	40–60	51.59	5.09
Low (*n* = 7)	5.7	25–39	25–35	32.14	3.39
EFS group					
Total participants (*n* = 73)	100	25–75	34–72	56.48	8.03
High (*n* = 23)	31.5	61–75	61–72	65.70	3.77
Average (*n* = 49)	67.1	40–60	40–60	52.61	4.86
Low (*n* = 1)	1.4	25–39	34	34	-
NFS group					
Total participants (*n* = 50)	100	25–75	25–68	57.86	8.50
High (*n* = 3)	6.0	61–75	61–68	65.33	3.79
Average (*n* = 41)	82.0	40–60	41–60	50.37	5.14
Low (*n* = 6)	12.0	25–39	25–35	31.83	3.60

5.3.1.3.2 Emotion-oriented coping dimension descriptive statistics

For the emotion-oriented coping dimension, the *T*-scores for the 123 aviation students ranged from 32 to 74, with a mean of 48.94 (*SD* = 10.06). Sixteen (13.0%) had high emotion-oriented coping *T*-scores ranging from 61 to 74, with a mean of 66.81 (*SD* = 4.12). The majority of the aviation students (*n* = 84, 68.3%) had average *T*-scores, ranging from 40 to 60, with mean of 49.35 (*SD* = 5.37). Another 23 aviation students (18.7%) had low scores for this coping dimension, and their *T*-scores ranged from 32 to 39, with a mean of 35.04 (*SD* = 2.51). A summary of the descriptive statistics for the emotion-oriented coping dimension is presented in Table 5.6.

Table 5.6

Descriptive Statistics for the CISS on the Emotion-oriented Coping Dimension

Group of participants	%	Possible range of *T*-scores	Observed range of *T*-scores	*M*	*SD*
All aviation students					
Total participants (*n* = 123)	100	25–75	32–74	48.94	10.06
High (*n* = 16)	13.0	61–75	61–74	66.81	4.12
Average (*n* = 84)	68.3	40–60	40–60	49.35	5.37
Low (*n* = 23)	18.7	25–39	32–39	35.04	2.51
EFS group					
Total participants (*n* = 73)	100	25–75	32–74	46.75	9.54
High (*n* = 6)	8.2	61–75	64–74	68.50	3.67
Average (*n* = 50)	68.5	40–60	40–58	48.10	4.81
Low (*n* = 17)	23.3	25–39	32–39	35.12	2.69
NFS group					
Total participants (*n* = 50)	100	25–75	32–74	42.64	11.50
High (*n* = 10)	20.0	61–75	61–74	65.80	4.21
Average (*n* = 34)	68.0	40–60	40–60	51.18	5.70
Low (*n* = 6)	12.0	25–39	32–38	34.83	2.14

For the EFS group, the 73 student pilots had emotion-oriented coping *T*-scores ranging from 32 to 74, with a mean of 46.75 (*SD* = 9.54). A minority of student pilots (*n* = 6, 8.2%) had high emotion *T*-scores ranging from 64 to 74, with a mean of 68.50 (*SD* = 3.67). The majority of the student pilots (*n* = 50, 68.5%) had average *T*-scores ranging from 40 to 58, with a mean of 48.10 (*SD* = 4.81). Another 17 student pilots (23.3%) had low emotion scores, with *T*-scores of 32–39, and a mean of 35.12 (*SD* = 2.69).

In the NFS group, the 50 students had emotion-oriented coping *T*-scores ranging from 32 to 74, with a mean of 42.64 (*SD* = 11.50). Ten students (20.0%) had high *T*-scores ranging from 61 to 74, with a mean of 65.80 (*SD* = 4.21). The majority of NFS group students (*n* = 34, 68.0%) had average *T*-scores ranging from of 40 to 60, with a mean of 51.18 (*SD* = 5.70). A minority of the students (*n* = 6, 12.0%) in the NFS group had low *T*-scores ranging from 32 to 38, with a mean of 34.83 (*SD* = 2.14).

5.3.1.3.3 Avoidance-oriented coping dimension descriptive statistics

With regard to responses to the avoidance-oriented coping dimension, the 123 aviation students' responses resulted in *T*-scores of 28–75, with a mean of 59.70 (*SD* = 11.23). The majority of the aviation students (*n* = 59, 48.0%) had high avoidance-oriented coping scores, and their *T*-scores ranged from 61 to 75, with a mean of 69.34 (*SD* = 5.18). There were 58 students (47.1%) who had average *T*-scores ranging from 40 to 60, with a mean of 52.71 (*SD* = 5.65). Only a small number of students (*n* = 6, 4.9%) had low scores on this coping dimension, with *T*-scores of 28–39, with a mean of 35.00 (*SD* = 4.00). Descriptive statistics for the avoidance-oriented coping dimension are summarised in Table 5.7.

In the EFS group, the total of 73 student pilots had avoidance-oriented coping *T*-scores ranging from 28 to 75, with a mean of 59.78 (*SD* = 11.34). There were 36 student pilots (49.3%) in this group with high avoidance *T*-scores ranging from 61 to 75, with a mean of 68.92 (*SD* = 5.52). There were 33 (45.2%) with average avoidance *T*-scores of 40–60, with a mean of 52.94 (*SD* = 5.35). Only a minority of student pilots (*n* = 4, 5.5%) had low avoidance-oriented coping *T*-scores ranging from 28 to 39, with a mean of 34.00 (*SD* = 4.69).

For the NFS group, the 50 students had avoidance-oriented coping *T*-scores ranging from 25 to 74, with a mean of 49.94 (*SD* = 10.70). Almost half of the students in this group (*n* = 23, 46.0%) had high *T*-scores for this dimension, ranging from 61 to 75, with a mean of 70.00 (*SD* = 4.65). Half (*n* = 25, 50.0%) had average s *T*-scores, ranging from 40 to 60, with a mean of 52.40 (*SD* = 6.13). Only two students (4.0%) had low avoidance *T*-scores, which ranged from 36 to 38, with a mean of 37.00 (*SD* = 1.41).

Table 5.7

Descriptive Statistics for the CISS on the Avoidance-oriented Coping Dimension

Group of participants	%	Possible range of *T*-scores	Observed range of *T*-scores	*M*	*SD*
All aviation students					
Total participants (*n* = 123)	100	25–75	28–75	59.70	11.23
High (*n* = 59)	48.0	61–75	61–75	69.34	5.18
Average (*n* = 58)	47.1	40–60	40–60	52.71	5.65
Low (*n* = 6)	4.9	25–39	28–39	35.00	4.00
EFS group					
Total participants (*n* = 73)	100	25–75	28–75	59.78	11.34
High (*n* = 36)	49.3	61–75	61–75	68.92	5.52
Average (*n* = 33)	45.2	40–60	40–60	52.94	5.35
Low (*n* = 4)	5.5	25–39	28–39	34.00	4.69
NFS group					
Total participants (*n* = 50)	100	25–75	36–74	49.94	10.70
High (*n* = 23)	46.0	61–75	61–75	70.00	4.65
Average (*n* = 25)	50.0	40–60	40–60	52.40	6.13
Low (*n* = 2)	4.0	25–39	36–38	37.00	1.41

In summary, the descriptive statistics indicate that the majority of the aviation students displayed average stress levels according to the PSS, followed by students in the low range, compared with participants in research studies that used the PSS questionnaire. With regard to CFI statistics, the EFS group had a much higher mean score than the NFS group. Furthermore, the descriptive statistics show that the majority of students in this study had average scores for both task-oriented coping and emotion-oriented coping, in comparison with participants in other studies that utilised the CISS questionnaire. Interestingly, more of the students in the EFS cohort had high task-oriented coping scores and low emotion-oriented coping scores than did those in the NFS. Furthermore, the largest numbers of students in both groups had higher scores for the avoidance-oriented coping dimension.

5.3.2 Inferential Statistics for Testing Hypotheses

In this section, the data analyses are presented using inferential statistics to test each hypothesis question with the statistical significance threshold set at $p < .05$ for all analyses.

5.3.2.1 Statistical Tests Applied for Hypothesis Testing

As in Study 1, the hypothesis questions in Study 2 were designed to validate the relationships between stress levels and cognitive flexibility levels, and the degree to which the aviation students preferred the three types of coping strategy; and to compare the values for each variable between the EFS and NFS groups and assess them within the EFS group itself. For this reason, four types of statistical analysis test were applied to test the hypotheses in Study 2.

5.3.2.1.1 Parametric tests

The statistical analyses in this study mainly applied parametric tests, including the Pearson's correlation coefficient test (to examine the relationship between existing variables as they occur naturally) and independent *t*-test (to examine the difference between two groups for a particular variable) as these provided more statistical power in relation to the non-parametric tests to reject null hypotheses. However, the data distribution must meet each test's assumptions. For example, the data must be measured at the interval/ratio level and data must be approximately normally distributed to achieve parametric statistical power. Before performing these two tests, the researcher confirmed that each test's assumptions were met.

5.3.2.1.2 Non-parametric tests

Non-parametric tests including the Spearman's correlation coefficient (the non-parametric equivalent of the Pearson's correlation coefficient) and Mann–Whitney U test (the non-parametric equivalent of the independent *t*-test) were applied to the hypotheses that did not meet the assumptions of parametric statistics. Hanna and Dempster (2012) suggest that the Spearman's correlation test can be applied to hypotheses when sample sizes as smaller than 30 people and when outliers are observed when assessing variables using scatterplots and skewness statistics. The Mann–Whitney U test is mostly applied to hypotheses where two independent samples vary in size, or one of the two samples has fewer than 30 subjects (Hanna & Dempster, 2012). Even though these tests provide lower statistical power than the parametric tests, they are valid in a broader range of situations as they do not rely on any distribution.

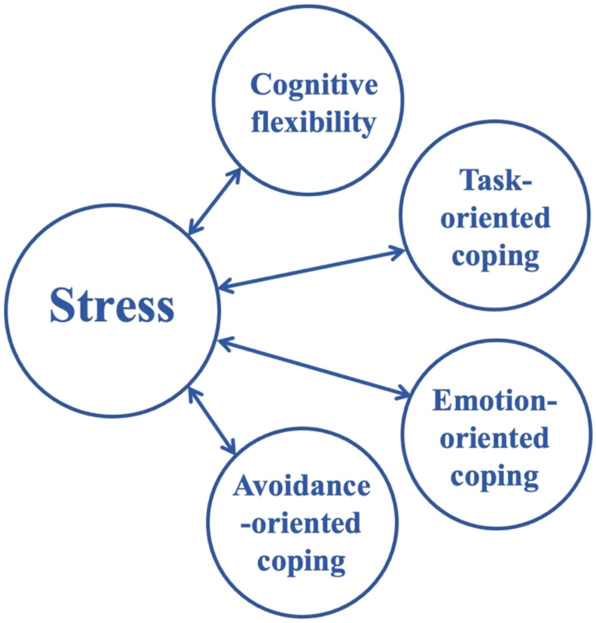
5.3.2.2 Testing H_1

$\boldsymbol{H_1}$ *For aviation students who show lower stress levels, a negative correlation is predicted between their cognitive flexibility and preference for task-oriented coping strategies. For aviation students who show higher stress levels, a positive correlation is predicted between the preference for emotion- and avoidance-oriented coping strategies.*

H_1 intended to investigate the 123 students' stress levels in relation to their cognitive flexibility levels and preferred coping strategy to identify any relationship between stress and these factors. The data were inspected in four dimensions: (1) the relationship between stress levels and cognitive flexibility levels; (2) the relationship between stress levels and the degree which task-oriented coping strategies were preferred; (3) the relationship between stress levels and the degree to which emotion-oriented coping strategies were preferred; and (4) the relationship between stress levels and the degree to adopt to which avoidance-oriented coping strategies were preferred. The hypothesised relationships are shown in Figure 5.2.

Figure 5.2

H_1–Hypothesised Relationships Between Stress, Cognitive Flexibility, and the Three Coping Strategies for the Participating Aviation Students



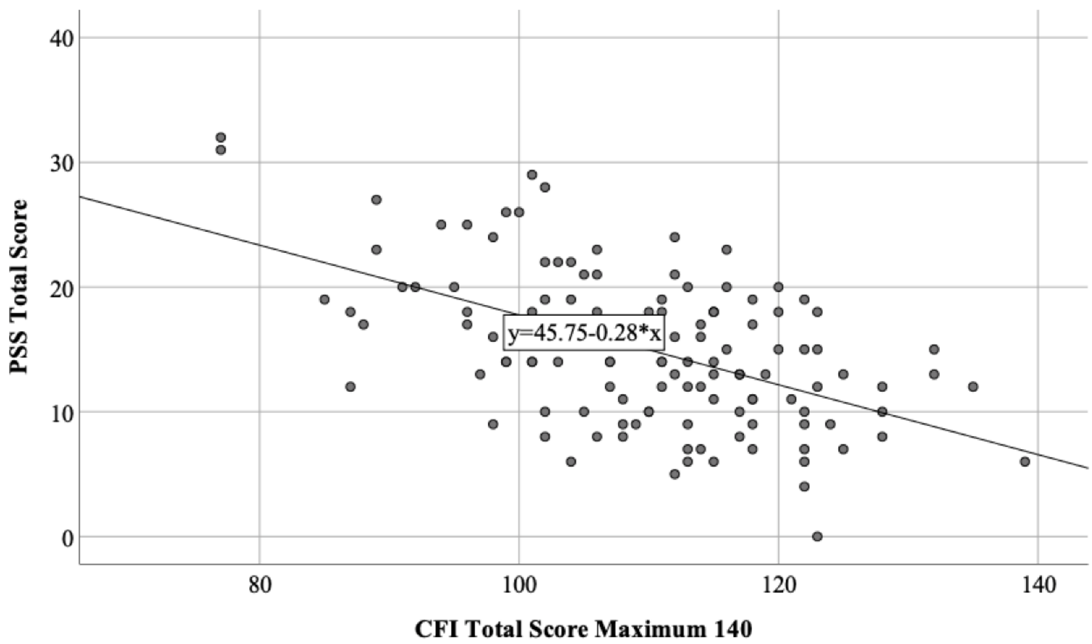
The parametric Pearson's correlation statistic was applied to statistical analysis to test H_1 for several reasons: (1) the sample size was larger than 30 and skewness ranged from –0.5 to 0.5, which indicated that the data were fairly symmetrical (Field, 2018); (2) the variables were measured at the interval level where scores can be ordered and the difference between each point on the scale is equal; and (3) scatterplots of variables indicate no substantial extreme scores or outliers. As all its assumptions were met, the Pearson's correlation test was considered the most suitable statistical analysis to apply to this study.

5.3.2.2.1 Stress versus cognitive flexibility

The first assessment administered was on the relationship between stress levels and cognitive flexibility levels. It was hypothesised that students with lower cognitive flexibility scores would have higher stress scores and vice versa. A Pearson's correlation test revealed a statistically significant negative correlation between students' PSS and CFI scores (see Figure 5.3): r (121) = –.53, 95% BCa CI [–.645, –.386], p = <.001. This suggests that students who had higher stress levels had lower cognitive flexibility levels and vice versa. The finding wholly supports H_1.

Figure 5.3

Scatterplot Displaying the Relationship Between PSS and CFI Scores for the Participating Aviation Students



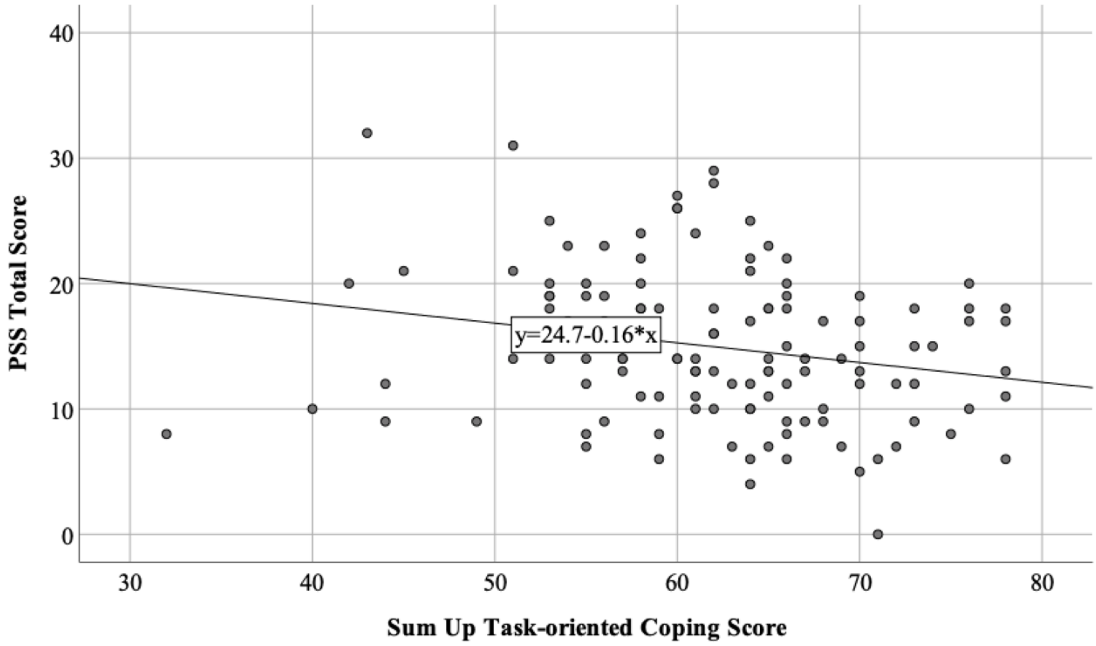
5.3.2.2.2 Stress versus task-oriented coping strategies

The second assessment of H_1 tested the relationship between stress levels and the degree which aviation students preferred task-oriented coping strategies. It was predicted that students with high stress levels preferred task-oriented coping methods to a lesser degree. A Pearson's correlation test assessed these students' PSS and CISS task-oriented dimension scores, revealing a statistically significant negative correlation (see Figure 5.4): r (121) = –.223, 95% BCa CI [–.409, –.039], p = .013;

that is, students with higher stress levels had a low preference for task-oriented coping strategies when coping with stressors. The finding wholly supports H_1.

Figure 5.4

Scatterplot Displaying the Relationship Between PSS and CISS Task-oriented Coping Dimension Scores for the Participating Aviation Students

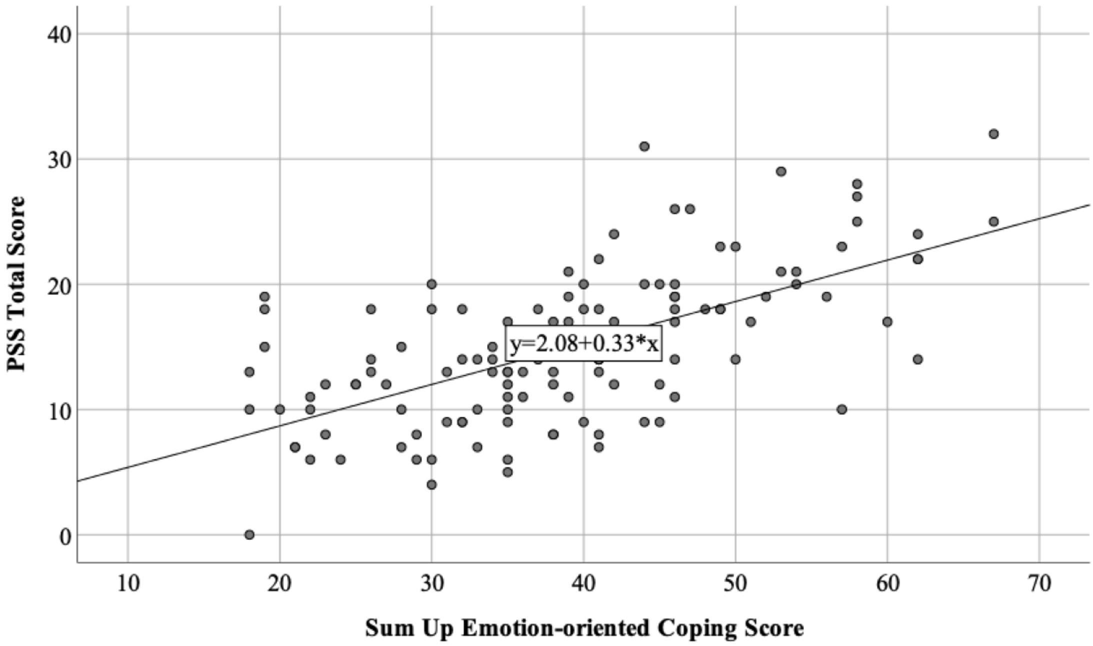


5.3.2.2.3 Stress versus emotion-oriented coping strategies

The next investigation focused on the relationship between stress levels and the degree of aviation students' preference for emotion-oriented coping methods. It was assumed that students with higher stress levels would have a higher preference for emotion-oriented coping strategies. A Pearson's correlation test revealed a statistically significant correlation between the students' PSS and CISS emotion-oriented dimension scores (see Figure 5.5), r (121) = .63, 95% BCa CI [.519, .731], p = <.001, suggesting that students' stress levels were positively correlated with their preference for emotion-oriented coping strategies. This result clearly supports the inference of H_1.

Figure 5.5

Scatterplot Displaying the Relationship Between PSS and CISS Emotion-oriented Coping Dimension Scores for the Participating Aviation Students

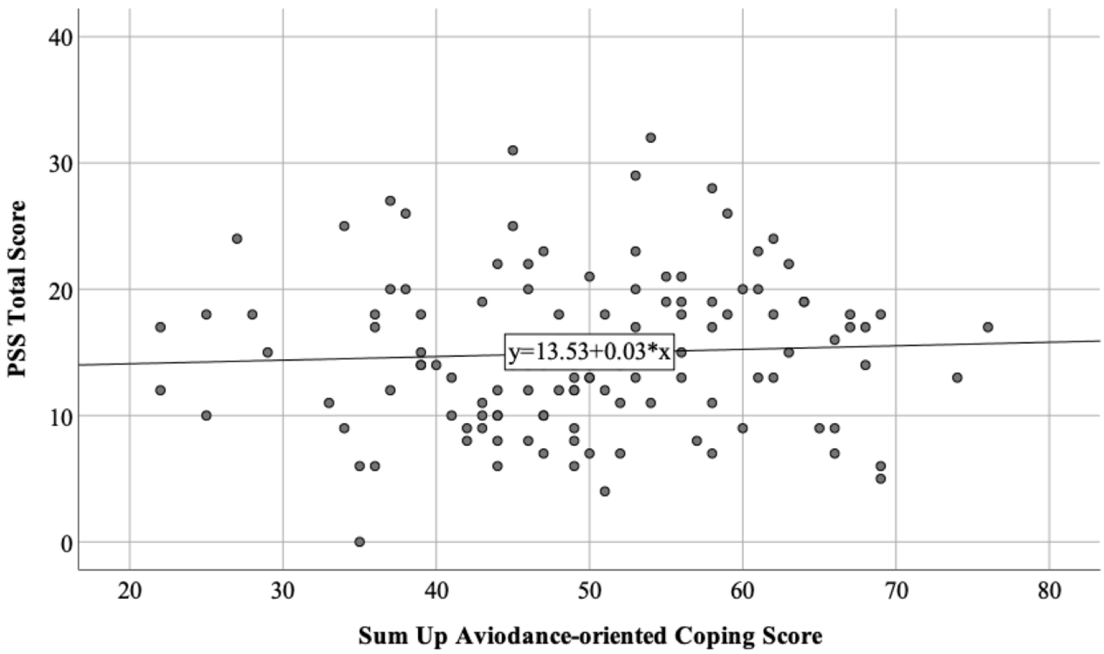


5.3.2.2.4 Stress versus avoidance-oriented coping strategies

The last part of H_1 refers to the relationship between students' stress levels and preference for avoidance-oriented coping methods. It was presumed that students who had higher stress levels would have a higher preference for avoidance-oriented coping methods. A Pearson's correlation test evaluating these students' PSS and CISS avoidance-oriented dimension scores revealed a weak positive correlation between them (see Figure 5.6): r (121) = .053, 95% BCa CI [–.117, .204], p = .56. Thus, the aviation students' stress levels were weakly correlated with their preference for avoidance-oriented coping methods. This finding does not support H_1.

Figure 5.6

Scatterplot Displaying the Relationship Between PSS and CISS Avoidance-oriented Coping Dimension Scores for the Participating Aviation Students



5.3.2.2.5 H_1 testing summary

In summary, the statistical analyses showed that the aviation students' stress levels were negatively correlated with their cognitive flexibility levels and the degree to which they preferred task- and emotion-oriented coping strategies. The group of students with higher stress levels had lower cognitive flexibility levels and a lower preference for task-oriented coping strategies but a higher preference for emotion-oriented coping strategies. These findings support H_1 except that the predicted correlation between stress levels and degree of preference for avoidance-oriented coping methods was not significant, albeit in the expected direction.

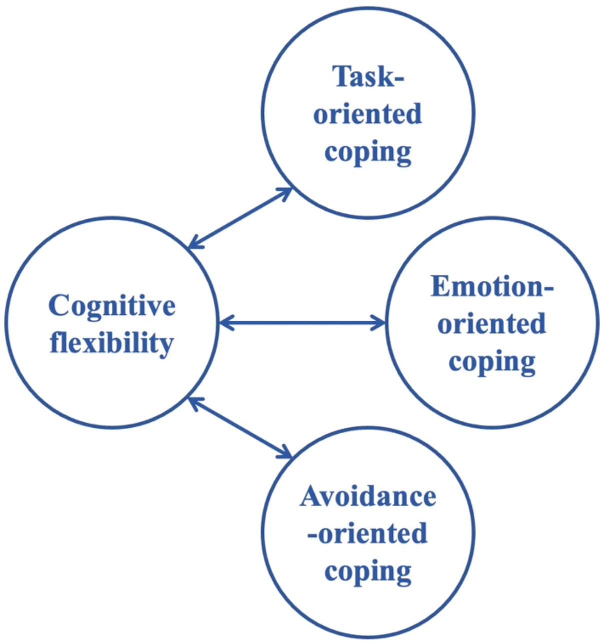
5.3.2.3 Testing H_2

$\boldsymbol{H_2}$ *Aviation students who show higher cognitive flexibility levels are predicted to prefer degree task-oriented coping strategies to a higher extent but emotion- and avoidance-oriented coping strategies to a lower extent.*

H_2 intended to investigate aviation students' cognitive flexibility levels in relation to their preference for different coping strategies. The data were inspected in three dimensions: (1) the relationship between cognitive flexibility levels and the degree to which task-oriented coping strategies were preferred; (2) the relationship between cognitive flexibility levels and the degree to which emotion-oriented coping strategies were preferred; and (3) the relationship between cognitive flexibility levels and the degree to which avoidance-oriented coping strategies were preferred. The hypothesised relationships are shown in Figure 5.7.

Figure 5.7

H_2–Hypothesised Relationships Between Cognitive Flexibility and the Three Coping Strategies for the Participating Aviation Students

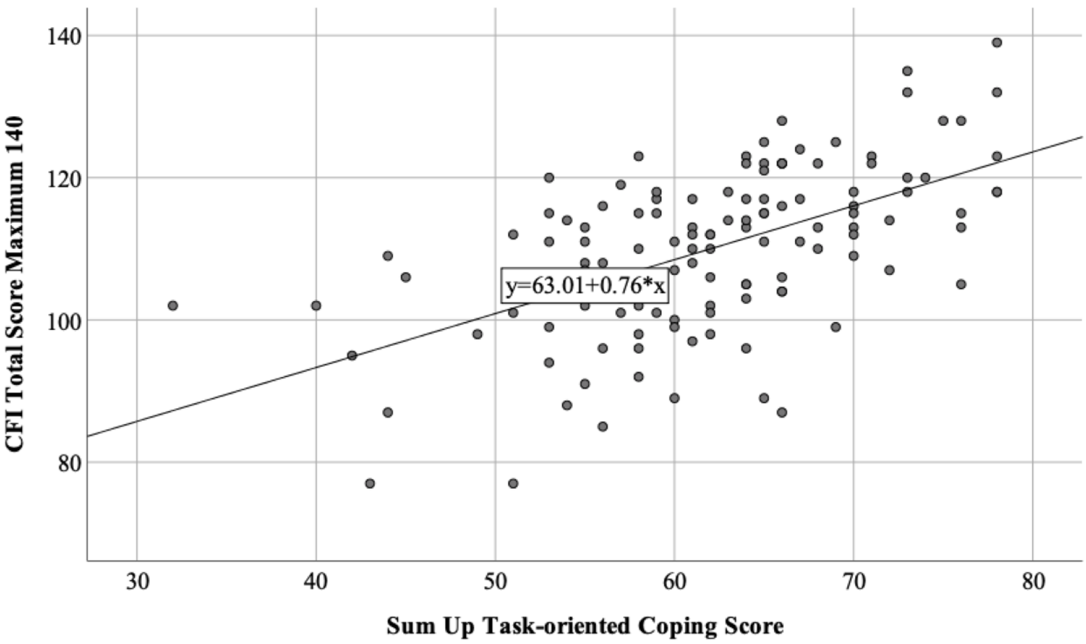


5.3.2.3.1 Cognitive flexibility versus task-oriented coping strategies

The first part of H_2 aimed to assess the relationship between cognitive flexibility levels and the degree to which subjects preferred task-oriented coping strategies. It was hypothesised that students with higher cognitive flexibility would have a higher preference for task-oriented coping strategies. A Pearson's correlation test revealed a strong significant positive correlation between CFI and task-oriented coping scores (see Figure 5.8), r (121) = 0.57, 95% BCa CI [.442, .665], p = <.001, suggesting that students with higher cognitive flexibility levels had a higher preference for task-oriented coping strategies when experiencing stress. This significant result wholly supports H_2.

Figure 5.8

Scatterplot Displaying the Relationship Between CFI and Task-oriented Coping Scores for the Participating Aviation Students

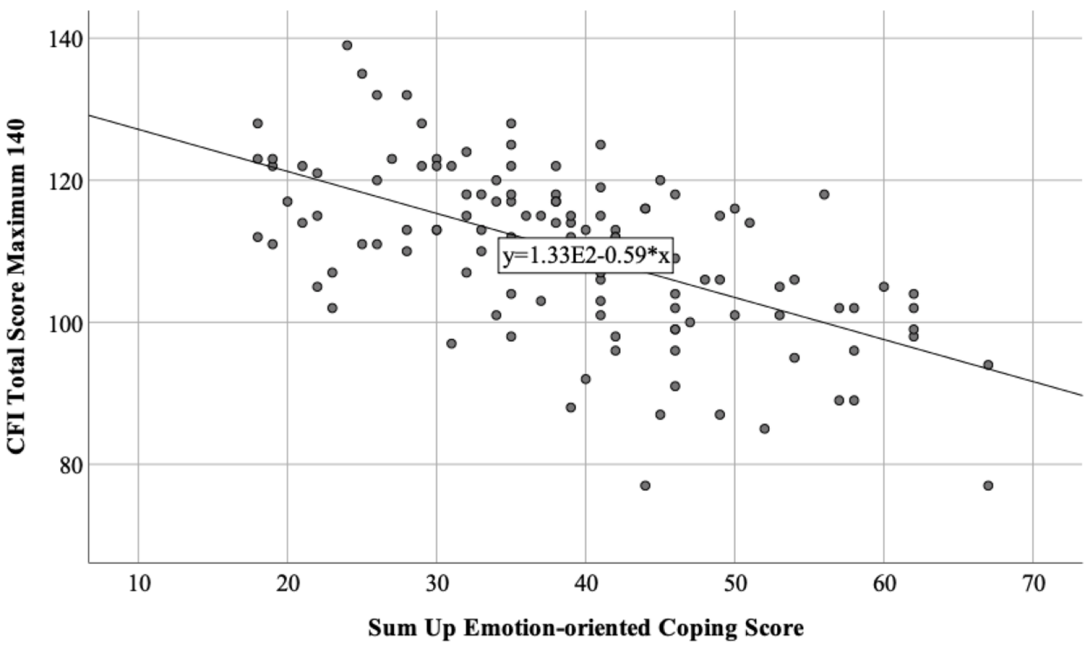


5.3.2.3.2 Cognitive flexibility versus emotion-oriented coping strategies

The second part of H_2 concerns the relationship between cognitive flexibility and the degree of preference for emotion-oriented coping strategies. It was hypothesised that students with higher cognitive flexibility would have a lower preference for emotion-oriented coping methods. To assess this, a Pearson's correlation test was applied to the CFI and emotion-oriented coping scores. The results show a statistically significant negative correlation (see Figure 5.9)—r (121) = –0.59, 95% BCa CI [–.689, –.486], p = <.001—suggesting that students with higher cognitive flexibility had a lower preference for emotion-oriented coping strategies when dealing with stressors. This finding clearly supports this part of H_2.

Figure 5.9

Scatterplot Displaying the Relationship Between CFI and Emotion-oriented Coping Scores for the Participating Aviation Students

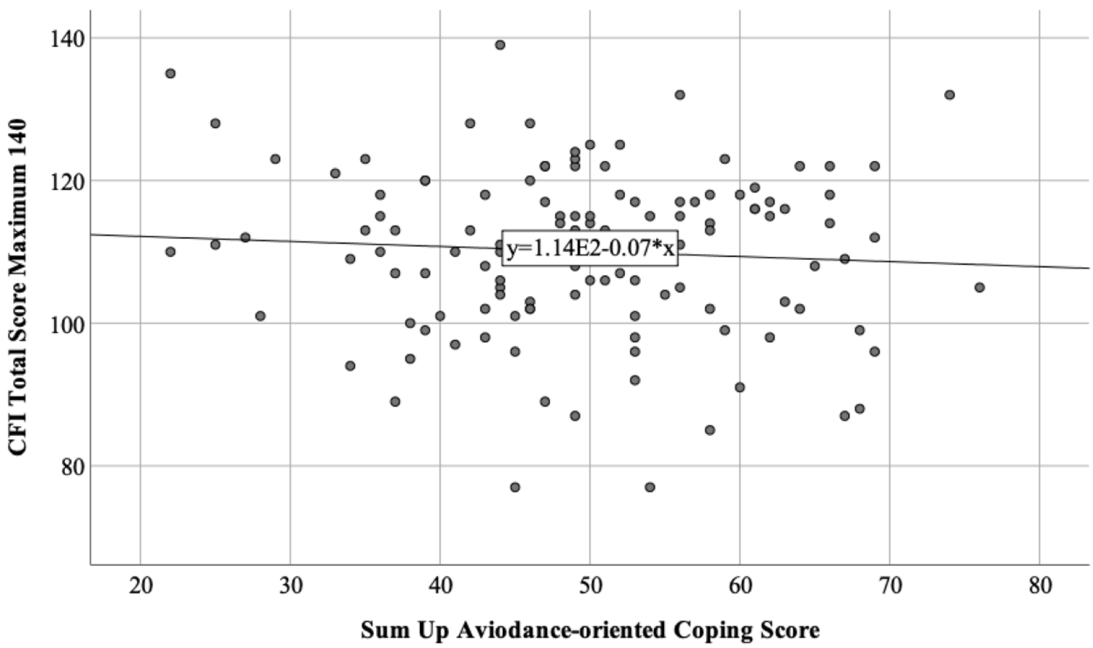


5.3.2.3.3 Cognitive flexibility versus avoidance-oriented coping strategies

The last part of H_2 concerns the relationship between cognitive flexibility and the degree to which avoidance-oriented coping strategies were preferred. It was hypothesised that students with higher cognitive flexibility would have a lower preference for avoidance-oriented coping methods. To assess the relationship between the two scores, a Pearson’s correlation was computed, which revealed a weak an insignificant negative correlation (see Figure 5.10); r (121) = –0.07, 95% BCa CI [–.258, .118], p = .45. While this suggests that students with higher cognitive flexibility might have a lower preference for avoidance-oriented coping strategies when they encounter a stressful situation, there was no statistical support for this aspect of H_2.

Figure 5.10

Scatterplot Displaying the Relationship Between CFI and Avoidance-oriented Coping Scores for the Participating Aviation Students



5.3.2.3.4 H_2 testing summary

In summary, Pearson’s correlation tests of the components of H_2 demonstrated that the aviation students with greater cognitive flexibility had a higher preference for task-oriented coping methods and a lower preference for emotion-oriented coping methods. However, in this set of data, there was no statistical validation that the students with lower cognitive flexibility had a higher preference for avoidance coping strategies, as higher cognitive flexibility students also used this coping method to a high degree when experiencing stress.

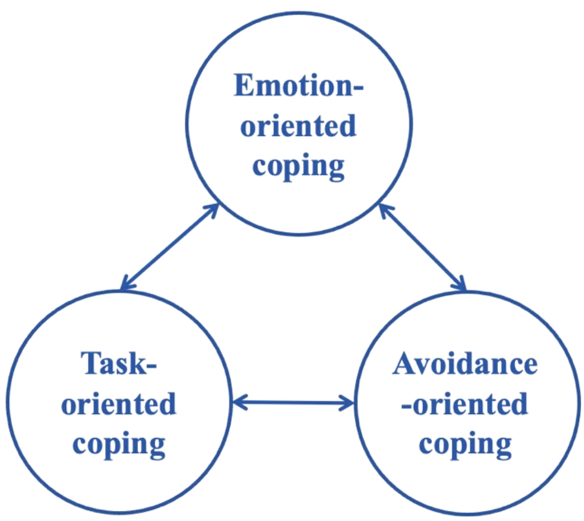
5.3.2.4 Testing H_3

H_3 *Aviation students who prefer emotion-oriented coping strategies to a higher extent are predicted to prefer task-oriented coping strategies to a lesser extent and avoidance-oriented coping strategies to a greater extent; whereas aviation students who prefer task-oriented coping strategies to a higher extent are predicted to prefer avoidance-oriented coping strategies to a lower extent.*

H_3 intended to investigate the relationship between preference for the three coping strategies based on the 123 students' responses to the CISS questionnaire. This assessment inspected three dimensions: (1) the relationship between preference for emotion- and task-oriented coping strategies; (2) the relationship between preference for emotion- and avoidance-oriented coping strategies; and (3) the relationship between preference for task- and avoidance-oriented coping strategies. The hypothesised relationships are shown in Figure 5.11.

Figure 5.11

H_3–Hypothesised Relationships Between Preference for the Three Coping Strategies among the Participating Aviation Students

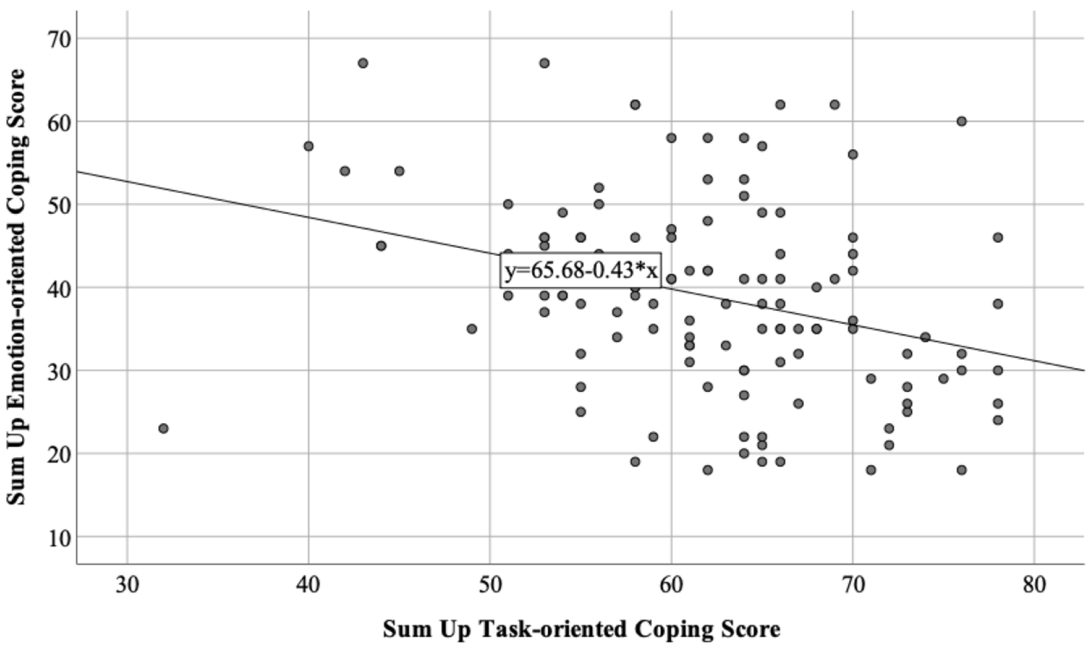


5.3.2.4.1 Emotion-oriented coping strategies versus task-oriented coping strategies

The investigation of the 123 students' scores for the emotion- and task-oriented coping dimensions tested the hypothesis that students who had a higher preference for emotion-oriented coping strategies would have a lower preference for task-oriented coping strategies when dealing with stress and vice versa. A Pearson's correlation test showed a strong significant negative correlation between the relevant scores (see Figure 5.12); r (121) = –0.32, 95% BCa CI [–.506, –.122], p = <.001. This result provides strong support for H3.

Figure 5.12

Scatterplot Displayed the Relationships Between the Emotion-oriented Coping Dimension and the Task-oriented Coping Dimension on the Group of Aviation Students

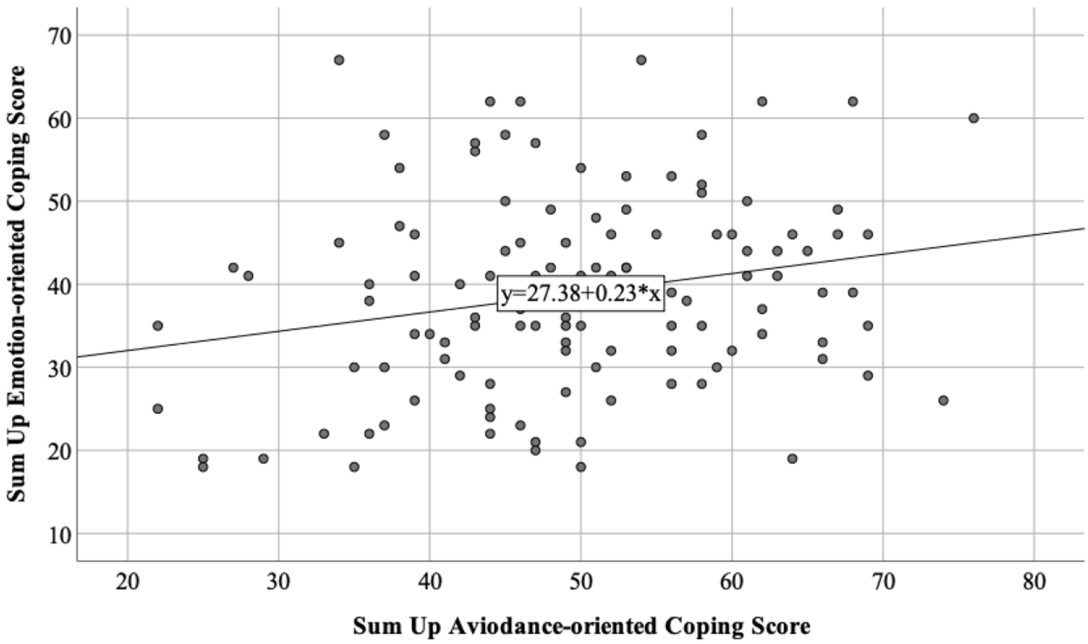


5.3.2.4.2 Emotion-oriented coping strategies versus avoidance-oriented coping strategies

The second assessment examined the relationship between the scores for emotion- and avoidance-oriented coping dimensions from the 123 responses. It was predicted that if students had a higher preference for emotion-oriented coping strategies, they would also have a higher preference for avoidance-oriented coping strategies. To test this assumption, a Pearson's correlation was performed on the emotion- and avoidance-oriented coping scores. The results reveal a statistically significant positive correlation between these two dimensions (see Figure 5.13): r (121) = .23, 95% BCa CI [.048, .406], p = .01. Thus, students with a higher preference for emotion-oriented coping strategies were likely also have a higher preference for avoidance-oriented coping strategies when experiencing stress. The finding from this study wholly supports this H_3.

Figure 5.13

Scatterplot Displayed the Relationships Between the Emotion-oriented Coping Dimension and the Avoidance-oriented Coping Dimension

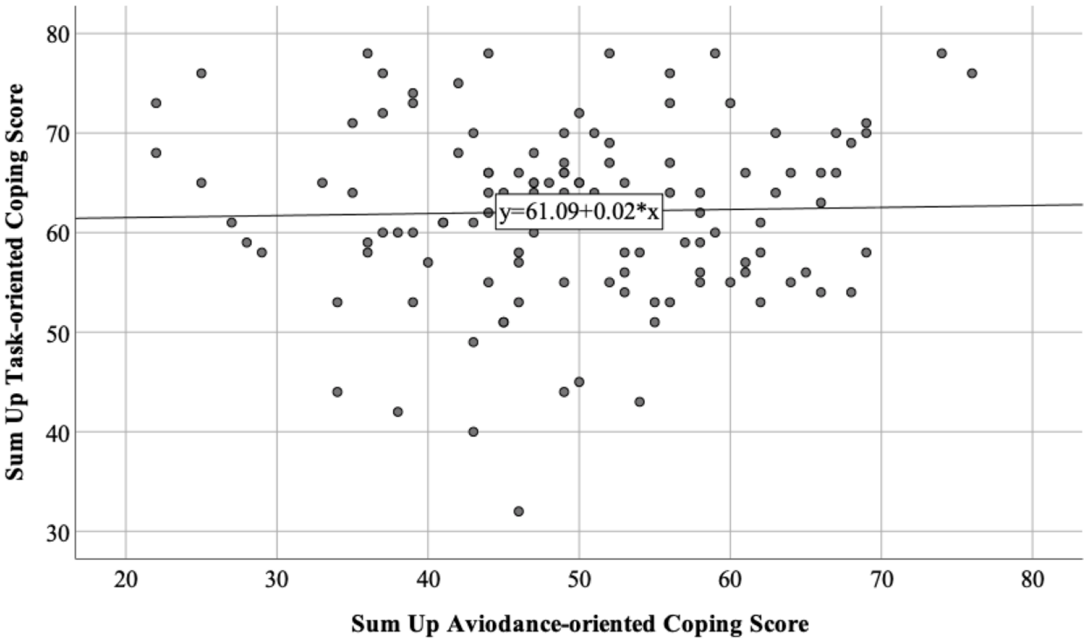


5.3.2.4.3 Task-oriented coping strategies versus avoidance-oriented coping strategies

The last assessment of H_3 inspected the relationship between task- and avoidance-oriented coping scores. It was hypothesised that the higher the students' preference for task-oriented coping strategies, the lower their preference for avoidance-oriented coping strategies, and vice versa. Pearson's correlation test results for the relationship between these two coping dimensions indicate no statistical correlation (see Figure 5.14): r (121) = .03, 95% BCa CI [–.151, .189], p = .77. Thus, there is no support for the hypothesis that aviation students with a higher preference for task-oriented coping strategies would have a lower preference for avoidance-oriented coping strategies when exposed to stressors.

Figure 5.14

Scatterplot Displayed the Relationships Between the Task-oriented Coping Dimension and the Avoidance-oriented Coping Dimension



5.3.2.4.4 H_3 testing summary

The findings in relation to H_3 indicate that aviation students with a higher preference for emotion-oriented coping methods also had a higher preference for avoidance-oriented coping methods but a lower preference for task-oriented coping methods compared with the group that had a lower preference for emotion-oriented coping strategies. Nevertheless, students with a lower preference for emotion-oriented coping methods, as expected, had a higher preference for task-oriented coping methods. However, the hypothesis that students with a higher preference for task-oriented coping strategies would have a lower preference for avoidance-oriented coping strategies is not supported, because students with a high preference for task-oriented coping strategies also had a high preference for avoidance-oriented coping strategies, and vice versa.

5.3.2.5 Testing H_4

H_4 *The EFS group is hypothesised to show lower stress levels and higher cognitive flexibility levels and prefer task-oriented coping strategies to a greater extent and emotion- and avoidance-oriented coping strategies to a lesser extent, than the NFS group.*

H_4 aimed to compare stress levels, cognitive flexibility levels and preferences for different coping strategies between the EFS and NFS groups to determine if they differed significantly in any of these factors. There were 73 students in the EFS group and 50 students in the NFS group (as shown in Table 5.8). The parametric independent t-test statistic was selected for statistical analysis in this part because H_4 aimed to compare two independent groups. In regard to the assumptions that must be met to run this parametric test, the sample sizes for each group were much larger than 30 and roughly equal so homogeneity of variance could be assumed (Hanna & Dempster, 2012). Furthermore, the data distributions in each group were approximately normal as shown by the bell-shaped distribution curves applied to the histograms in Figures 5.15–5.19. Also, the variables were measured at the interval level. Therefore, the parametric independent t-test was considered the most suitable for this hypothesis as all its assumptions criteria were met.

Table 5.8

Summed Scores for the EFS and NFS Groups Based on Responses for the PSS, CFI, Task-oriented, Emotion-oriented and Avoidance-oriented Coping Strategies

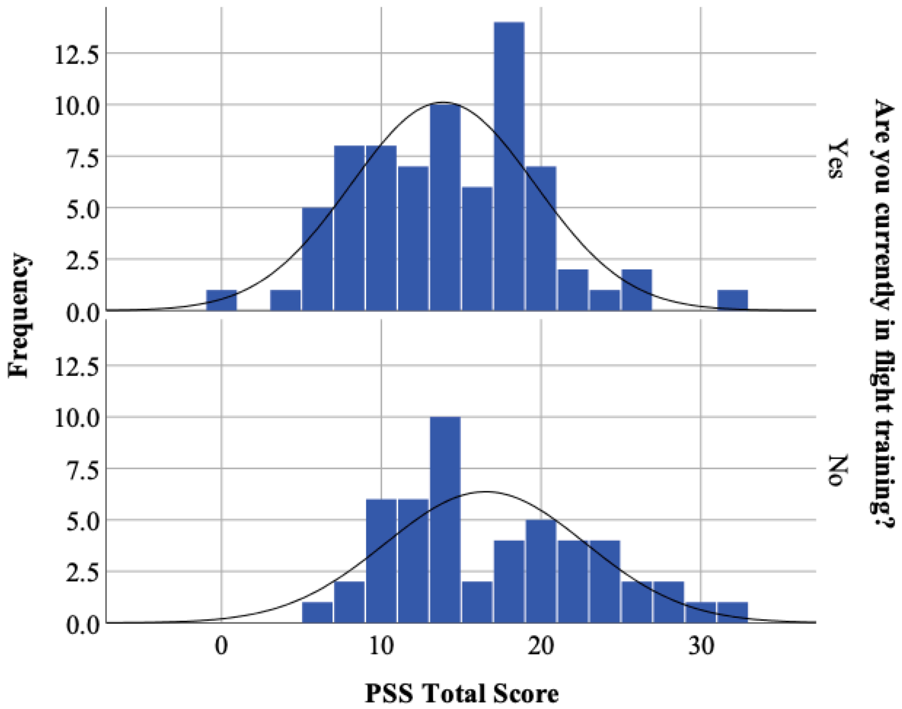
Survey overall scores / Participant group		PSS	CFI	Task	Emotion	Avoidance
	Min	0	77	43	18	22
	Max	32	139	78	67	76
	M	13.86	112.74	65.01	36.32	49.40
	SD	5.76	10.98	7.51	11.02	11.74
EFS group (*n* =73)	Min	0	77	43	18	22
	Max	32	139	78	67	76
	M	13.86	112.74	65.01	36.32	49.40
	SD	5.76	10.98	7.51	11.02	11.74
NFS group (*n* =50)	Min	5	77	32	18	25
	Max	31	128	76	67	69
	M	16.52	106.16	57.86	42.64	49.94
	SD	6.27	11.44	8.50	11.50	10.70
Total (123)						

5.3.2.5.1 Comparison of stress levels between the EFS and NFS groups

The first part of H_4 aimed to test for a significant difference between the EFS and NFS groups in their stress levels (see Figure 5.15). An independent *t*-test was performed on the responses of the EFS and NFS groups to the PSS survey questions. The results show a statistically significant difference between these two groups in their responses to the PSS questionnaire, $t\ (121) = 3.21$, $p = .017$, suggesting that the group of NFS had significantly higher stress levels than the group of EFS.

Figure 5.15

Histograms of PSS Scores for the Groups of EFS (Top) and NFS (Bottom) Groups

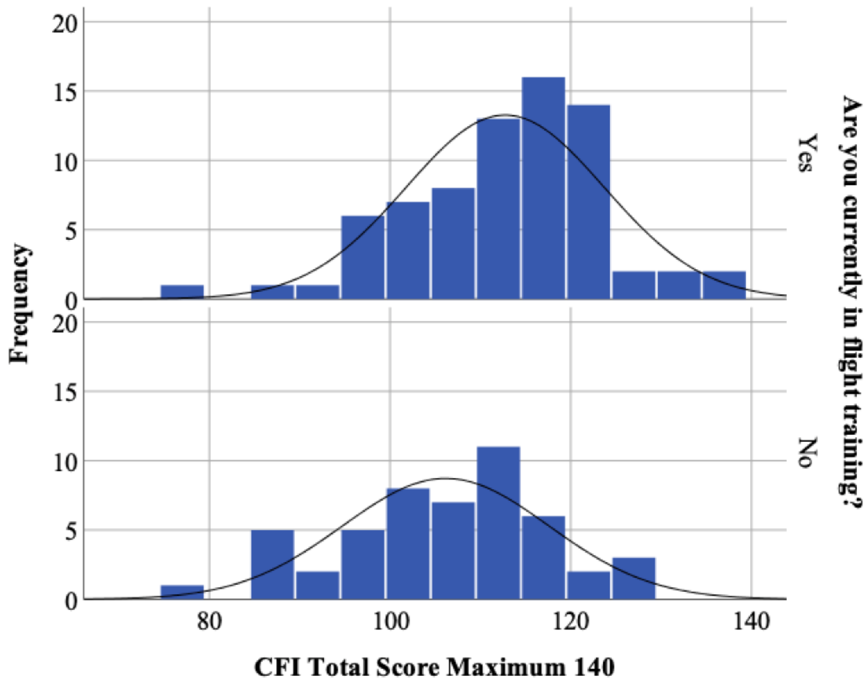


5.3.2.5.2 Comparison of cognitive flexibility levels between the EFS and NFS groups

The second part of H_4 relates to whether higher cognitive flexibility would be observed for the group of EFS than for the group of NFS (see Figure 5.16). An independent *t*-test was computed to test the significance of any difference between the two groups on their responses to the CFI questionnaire. The results show a statistically significant difference, indicating that the group of EFS had significantly higher cognitive flexibility levels than the group of NFS: $t\,(121) = 3.21$, $p = .002$.

Figure 5.16

Histograms of CFI Scores for the Groups of EFS (Top) and NFS (Bottom) Groups

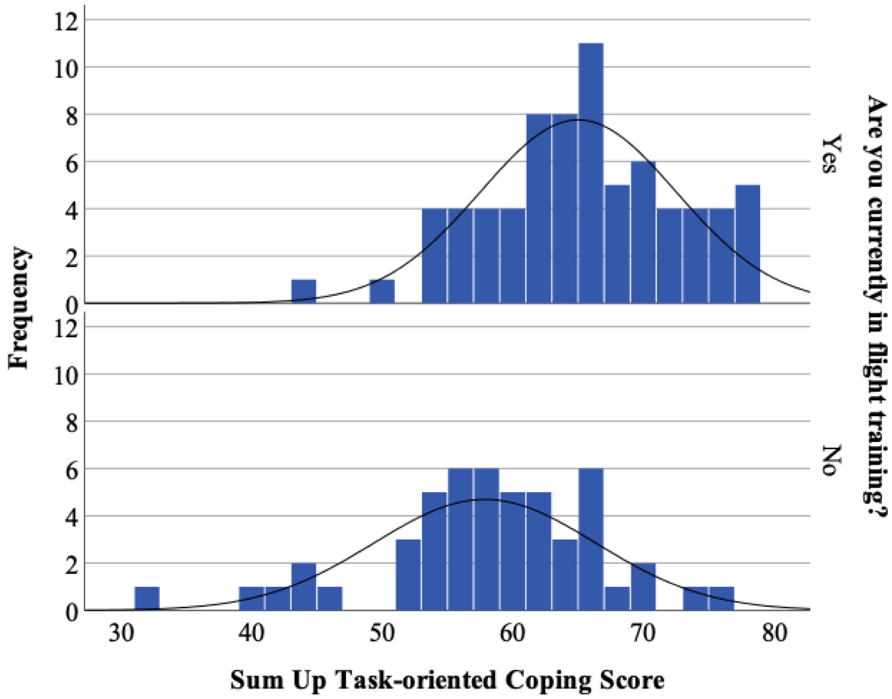


5.3.2.5.3 Comparison between the groups of EFS and NFS in their preference for task-oriented coping

The third part of H_4 intended to identify whether the group of EFS was likely to have a higher preference for task-oriented coping strategies than the group of NFS (see Figure 5.17). An independent *t*-test was performed to test for a difference in their responses to the CISS task-oriented coping dimension. This revealed a statistically significant difference between the two groups in their responses to the CISS task-oriented coping dimension: t (121) = 4.92, p = <.001. The group of EFS had a significantly higher preference for task-oriented coping strategies than the group of NFS when experiencing a stressful situation.

Figure 5.17

Histograms of Task-oriented Coping Scores for the Groups of EFS (Top) and NFS (Bottom) Groups

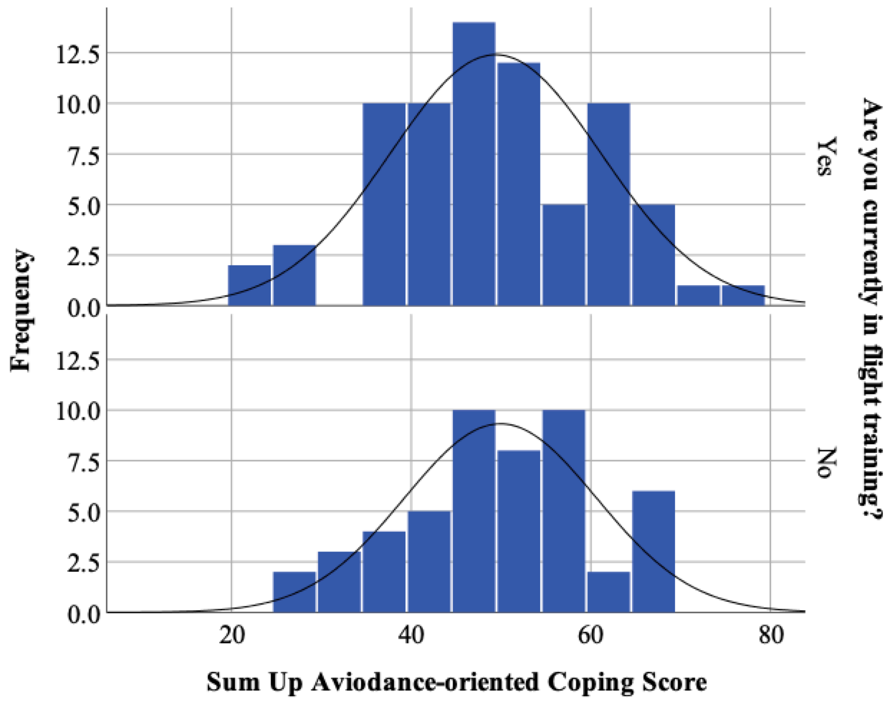


5.3.2.5.4 Comparison between the groups of EFS and NFS in their preference for avoidance-oriented coping

The next part of H_4 attempted to investigate whether the group of NFS would show a higher preference for avoidance-oriented coping strategies than the group of EFS when coping with stress (see Figure 5.18). An independent *t*-test was computed to discover whether these two groups showed a statistical difference in their avoidance-oriented coping scores. No significant difference was found between the two groups' responses to the avoidance-oriented coping dimension, t (121) = –.26, p = .80, suggesting that these groups of students had similar preferences for avoidance-oriented coping strategies when coping with stress.

Figure 5.18

Histograms of Avoidance-oriented Coping Scores for the Groups of EFS (Top) and NFS (Bottom) Groups

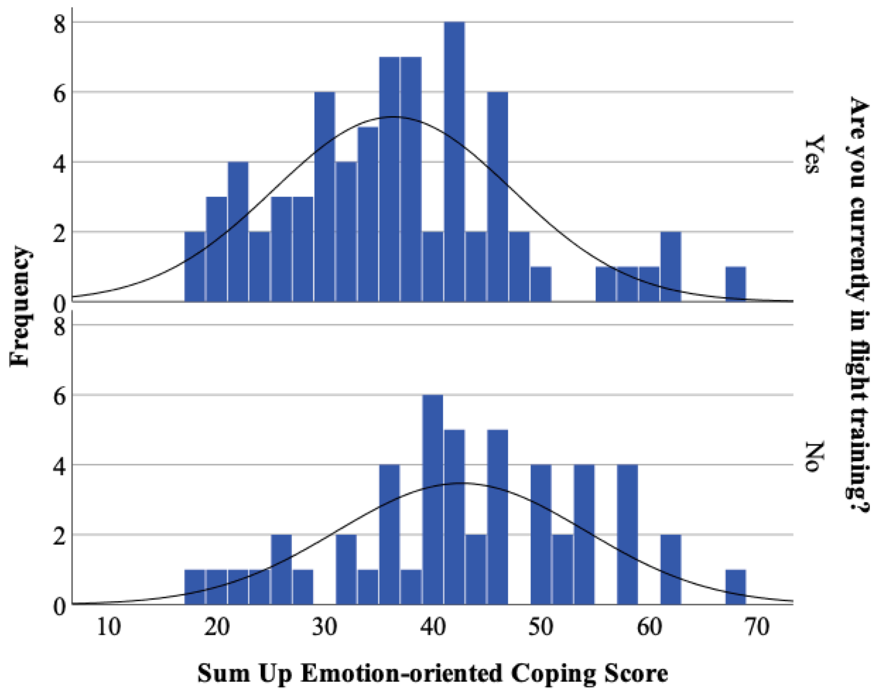


5.3.2.5.5 Comparison between the groups of EFS and NFS in their preference for emotion-oriented coping

The last part of H_4 investigated whether the NFS group had a higher preference for emotion-oriented coping strategies than the EFS group when they experienced stress (see Figure 5.19). An independent *t*-test was performed on these two groups to identify whether there was a significant difference in their preferences for emotion-oriented coping strategies. The results show a statistically significant difference between the two in their responses to the emotion-oriented coping dimension: t (121) = –3.07, p = .003. This suggests that the NFS group had a significantly higher preference for emotion-oriented coping strategies than the EFS group when coping with stress.

Figure 5.19

Histograms of Emotion-oriented Coping Scores for the Groups of EFS (Top) and NFS (Bottom) Groups



5.3.2.5.6 H_4 testing summary

To test H_4, a number of independent *t*-tests were performed between the groups of EFS and NFS to compare their stress levels, cognitive flexibility levels and preferences for the three types of coping method. The statistical test results show that the EFS group had significantly lower stress scores and higher cognitive flexibility levels than the NFS group. Furthermore, it was verified that the EFS group showed a higher preference for task-oriented coping strategies than the NFS group, whereas the NFS group had a higher preference for emotion-oriented coping methods than the EFS group. However, both groups appeared to have a similar preference for avoidance-oriented coping methods when coping with stress.

5.3.2.6 Testing H_5

H_5 *Aviation students' stress levels are expected to decrease, and cognitive flexibility levels to increase, with older age. Also, older students are predicted to prefer task-oriented coping strategies to a greater extent and emotion- and avoidance-oriented coping strategies to a lesser extent, than young students.*

This hypothesis aimed to examine the relationships between the aviation students' age and their stress levels, cognitive flexibility levels and preference for different types of coping method. This was examined in five ways: (1) the relationship between age and stress level; (2) the relationship between age and cognitive flexibility level; (3) the relationship between age and preference for task-oriented coping strategies;(4) the relationship between age and preference for emotion-oriented coping strategies; and (5) the relationship between age and preference for avoidance-oriented coping strategies.

5.3.2.6.1 Relationship between age and stress level

The first investigation concerned the relationship between students' ages and stress levels. It was predicted that stress levels would decrease with increasing age. To test, a Pearson's correlation test was performed on these students' age and their PSS scores. There was no statistically significant correlation between student age and stress level; $r = -.039$, $n = 123$, $p = .67$. Thus, students' age did not affect their stress levels as both younger and older students could display higher or lower levels of stress.

5.3.2.6.2 Relationship between age and cognitive flexibility level

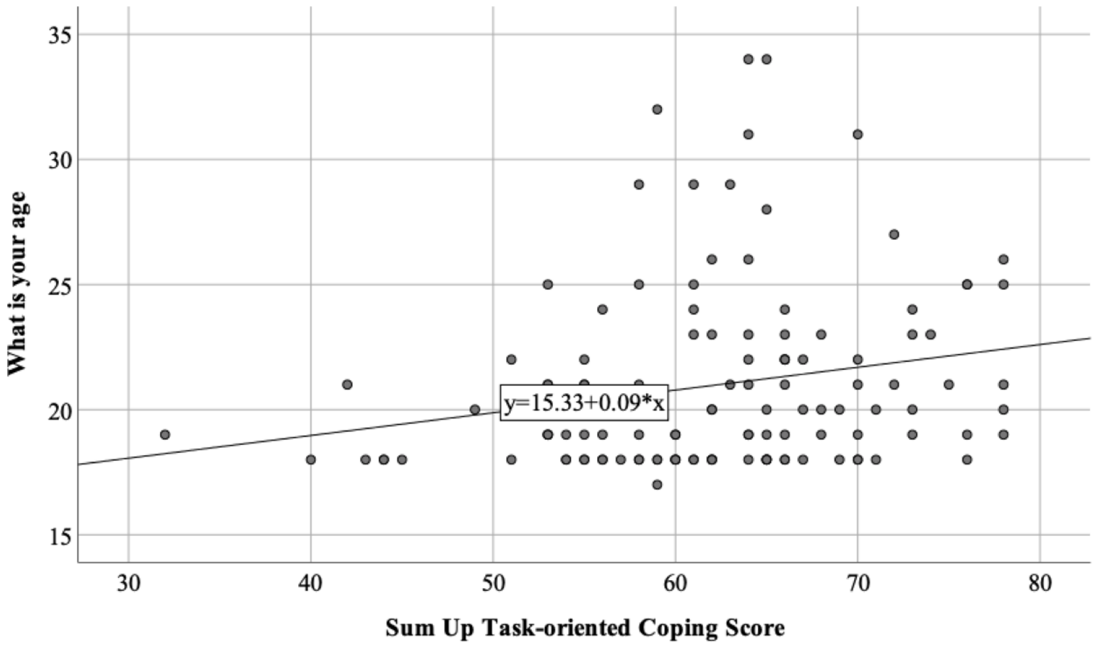
The relationship between age and cognitive flexibility of the students was the next aspect of H_5 to be tested. It was predicted that the older the students, the higher the cognitive flexibility level they would display. A Pearson's correlation test used to examine the relationship between these students' age and their CFI scores. No statistically significant correlation was found; $r = .10$, $n = 123$, $p = .28$. Thus, the group of young students were as cognitively flexible as the older student group.

5.3.2.6.3 Relationship between age and preference for task-oriented coping

The third area of interest under H_5 was the relationship between student age and their preference for task-oriented coping strategies. It was hypothesised that students' preference for task-oriented coping strategies would be greater when they were older. A Pearson's correlation test of age versus CISS task-oriented coping scores found a statistically significant positive correlation between students' age and their preference for task-oriented coping strategies (see Figure 5.20): $r = .22$, $n = 123$, $p = .017$. Thus, the older the students were more likely than young students to prefer task-oriented coping strategies when exposed to a stressful situation.

Figure 5.20

Scatterplot Displaying the Relationship Between Students' Age and Their Task-oriented Coping Scores



5.3.2.6.4 Relationship between age and preference for emotion-oriented coping

Part of H_5 aimed to test the relationship between student age and preference for emotion-oriented coping strategies. It was predicted that the preference for emotion-oriented coping strategies would decline with age. A Pearson's correlation test was executed to examine the relationship between age and CISS emotion-oriented coping scores for the students, which revealed no statistically significant correlation between age and preference for emotion-oriented coping strategies; $r = -.047$, $n = 123$, $p = .60$. This highlights that students had similar preferences for emotion-oriented coping strategies in the face of stress regardless of their age.

5.3.2.6.5 Relationship between age and preference for avoidance-oriented coping

H_5 also refers to the relationship between student's age and preference for avoidance-oriented coping strategies. It was expected that students would have a lower preference for avoidance-oriented coping strategies as they got older. A Pearson's correlation test indicated a weak but insignificant negative correlation between student age and preference for avoidance-oriented coping strategies: $r = -.128$, $n = 123$, $p = .16$. This suggests that increasing age did not significantly reduce the preference for avoidance-oriented coping strategies.

5.3.2.6.6 H_5 testing summary

A battery of Pearson's correlation tests revealed no significant correlations between students' age and their stress levels, cognitive flexibility levels and preferences for different coping methods, with the exception of task-oriented coping methods. Stress levels were largely unaffected by age, while cognitive flexibility differed to some degree, but not significantly so. Age also did not influence the preference for emotion- or avoidance-oriented coping strategies as both older and younger students preferred these to a similar degree. However, increasing age was significantly associated with students' preference for task-oriented coping methods in the face of stress. Accordingly, based on the inferential statistics, it can be concluded that age affects neither students' stress levels, cognitive flexibility levels nor their preferences for emotion- or avoidance-oriented coping strategies. However, age can influence the preference for task-oriented coping strategies among aviation students under stress.

5.3.2.7 Testing H_6

H_6 *Male and female aviation students are expected to show the same cognitive flexibility levels and a similar preference for avoidance-oriented coping strategies. However, males are predicted to show lower stress levels and to prefer task-oriented coping strategies to a higher degree than females, who are predicted to show higher stress levels and prefer emotion-oriented coping strategies to a greater extent.*

H_6 focuses on testing for gender differences in preferred coping method when student pilots experience stressors. It was hypothesised that males and females would show the same level of cognitive flexibility but that males would have lower stress scores and higher preference for task-oriented coping methods than females; conversely, females would have higher stress scores and a stronger preference for emotion-oriented coping methods than males. The 123 aviation students were separated into two groups: 94 males and 29 females (Table 5.9). Parametric statistic independent *t*-test were applied to test the various components of H_6.

Table 5.9

Summary of Scores for Students With Different Gender Based on their Responses Regarding PSS, CFI, and Task- and Emotion and Avoidance-oriented Coping Strategies

Survey overall scores / **Participant group**		**PSS**	**CFI**	**Task**	**Emotion**	**Avoidance**
	Min	0	77	43	18	22
	Max	32	139	78	67	76
	M	13.86	112.74	65.01	36.32	49.40
	SD	5.76	10.98	7.51	11.02	11.74
Males (n = 94)	Min	0	77	32	18	22
	Max	32	139	78	67	76
	M	14.45	109.72	61.90	38.37	49.79
	SD	6.07	11.45	8.74	12.16	11.46
Females (n = 29)	Min	7	89	44	25	22
	Max	29	135	78	58	74
	M	16.55	111.17	62.76	40.55	49.07
	SD	5.99	12.15	8.45	9.56	10.88
Total (123)						

As the numbers of students in the male and female groups were quite different and the variable was measured at the ordinal level, a non-parametric Mann–Whitney U test was considered the most suitable statistical tool to test this hypothesis.

5.3.2.7.1 Comparison of stress levels between genders

The first part of H_6 aimed to test for a difference in male and female stress levels according to responses to the PSS questionnaire. An independent *t*-test revealed a weak but insignificant difference between the genders in their responses to the PSS questionnaire: $t\ (121) = -1.64$, $p = .10$. The females had a higher degree of stress than the males according to the mean scores, but not significantly so.

5.3.2.7.2 Comparison of cognitive flexibility levels between genders

It was predicted that males and females would show the same cognitive flexibility levels. An independent *t*-test was computed on the CFI mean scores of males and females to identify whether there was a significant difference between them. The results show no significant difference, $t\ (121) = -5.87$, $p = .56$, indicating that the groups of male and female aviation students had a similar degree of cognitive flexibility.

5.3.2.7.3 Comparison of the preference for task-oriented coping strategies between genders

The third part of H_6 aimed to identify whether the group of male students had a higher preference for task-oriented coping strategies than the group of female students when coping with stress. An independent *t*-test was performed to compare these genders' task-oriented coping scores, which revealed that the slightly higher mean scores the female group was not a significant difference: $t\ (121) = -4.64$, $p = .64$. Thus, that the male and female students had similar preferences for task-oriented coping methods when coping with stress.

5.3.2.7.4 Comparison of the preference for emotion-oriented coping strategies between genders

This part of H_6 sought to test for a gender difference in preference for emotion-oriented coping methods. It was hypothesised that male students would have a lower preference for emotion-oriented coping methods than female students when experiencing stress. An independent *t*-test found no statistically significant difference between the male and female groups in their preference for emotion-oriented coping methods, although the male group had a slightly lower mean score than the female group: t (121) = –.88, p = .38. Thus, the male and female students had similar preferences for emotion-oriented coping methods when coping with stress.

5.3.2.7.5 Comparison of the preference for avoidance-oriented coping strategies between genders

The final part of H_6 aimed to determine where there was a difference between male and female aviation students in their preference for avoidance-oriented coping methods. The independent *t*-test results show that there was no significant difference between the genders on their avoidance-oriented coping scores: t (121) = .30, p = .77. This suggests that the groups of male and female students had a similar preference for avoidance-oriented coping methods when coping with stress.

5.3.2.7.6 H_6 testing summary

As confirmed by a number of independent *t*-tests, male and female aviation students showed a similar degree of cognitive flexibility levels, which supports the first part of the hypothesis. Additionally, the genders did not differ in their preference for task- and emotion-oriented coping strategies in their encounters with stress. Females had higher stress mean scores than males, although this was not statistically significant.

5.3.2.8 Testing H_7

H_7 *In the EFS group, student pilots who have completed flight training as a degree requirement are expected to show higher stress levels than those who have not. However, EFS group cognitive flexibility levels and preference for the three coping strategies is expected to be the same as those of the NFS group.*

This hypothesis intended to examine whether the increased responsibility and workload from completing a university degree would increase student pilots' stress levels, and whether their cognitive flexibility levels and preferences for the three coping strategies would differ between students who had graduated and those who had not. To test this hypothesis, the group of 73 student pilots was divided into subgroups of degree (n = 34, 46.6%) and non-degree students (n = 39, 53.4%) as shown in Table 5.10. The parametric independent t-test was used to assess H_7, as all its assumptions were met.

Table 5.10

Summary of Scores for Non-degree and Degree Students Based on Responses to the PSS, CFI, and Three Coping Dimensions

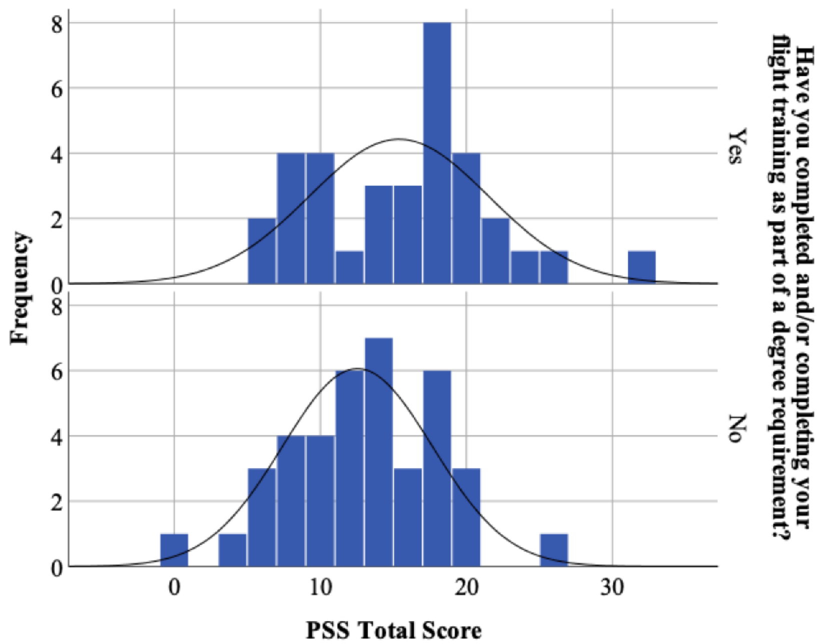
Survey overall scores / **Participant group**		**PSS**	**CFI**	**Task**	**Emotion**	**Avoidance**
	Min	0	77	43	18	22
	Max	32	139	78	67	76
	M	13.86	112.74	65.01	36.32	49.40
	SD	5.76	10.98	7.51	11.02	11.74
Non-degree group (n = 39)	Min	0	96	49	18	22
	Max	25	135	78	58	74
	M	12.54	113.56	65.33	34.92	47.85
	SD	5.13	9.05	7.18	9.64	12.80
Degree group (n = 34)	Min	6	77	43	18	28
	Max	32	139	78	67	76
	M	15.38	111.79	64.65	37.91	51.18
	SD	6.13	12.91	7.96	12.37	10.29
Total (73)						

5.3.2.8.1 Comparison of stress levels between the non-degree and degree groups

The primary prediction of H_7 inferred was that the degree students would experience higher stress levels than the non-degree students. An independent *t*-test was performed to test for a difference between these two groups' stress levels based on PSS scores (see Figure 5.21). A significant difference was found, t (71) = 2.16, p = .03, whereby the degree group had significantly higher stress levels than the non-degree group, which might be due to the increased responsibility and workload of their university studies.

Figure 5.21

Histograms of PSS Scores for the Groups of Non-degree (Bottom) and Degree (Top) Students

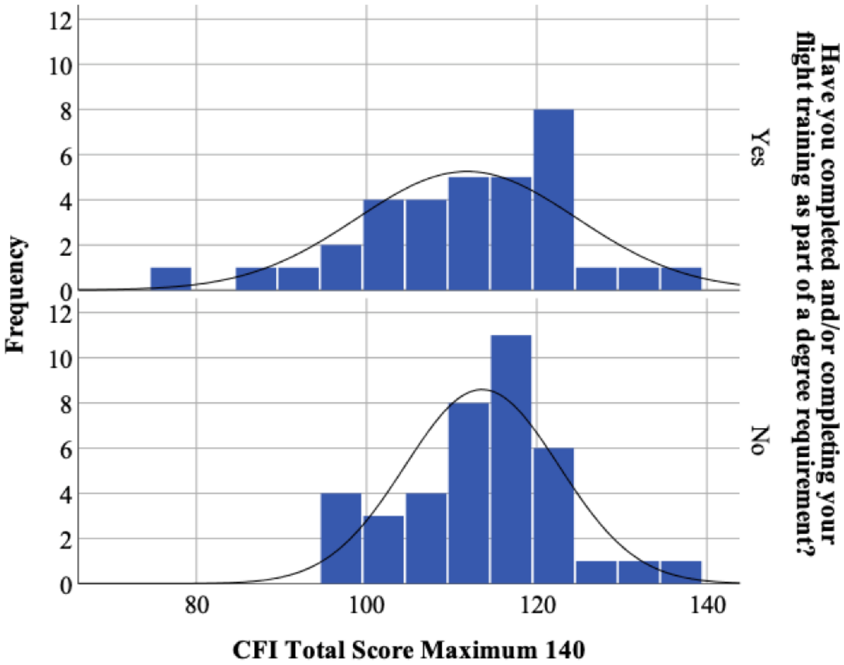


5.3.2.8.2 Comparison of cognitive flexibility levels between the non-degree and degree groups

The next part of H_7 aimed to test whether cognitive flexibility levels differed between the non-degree and degree groups. An independent *t*-test was applied to test for a significant difference between the two groups in cognitive flexibility levels. There was no statistically significant difference in their responses to the CFI questionnaire (see Figure 5.22): t (71) = –.69, p = .50. This suggests that non-degree and degree students had similar levels of cognitive flexibility.

Figure 5.22

Histograms of CFI Scores for the Groups of Non-degree (Bottom) and Degree (Top) Students

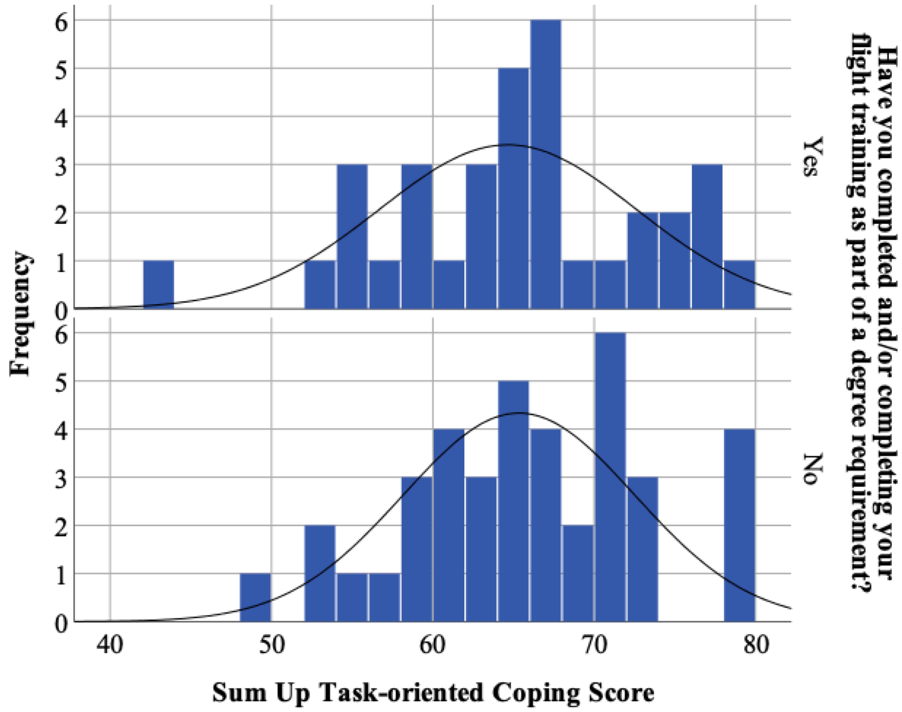


5.3.2.8.3 Comparison of preference for task-oriented coping strategies between the non-degree and degree groups

The third part of H_7 aimed to identify any difference between the non-degree and degree groups in their preference for task-oriented coping strategies. The independent t-test of the difference between these groups in their task-oriented coping scores showed no statistically significant difference (see Figure 5.23): t (71) = –.39, p = .70. Therefore, it could be inferred that the increased workload and responsibility did not alter the aviation students' preferences for task-oriented coping strategies.

Figure 5.23

Histograms of CISS Task-oriented Coping Scores for the Groups of Non-degree (Bottom) and Degree (Top) Students

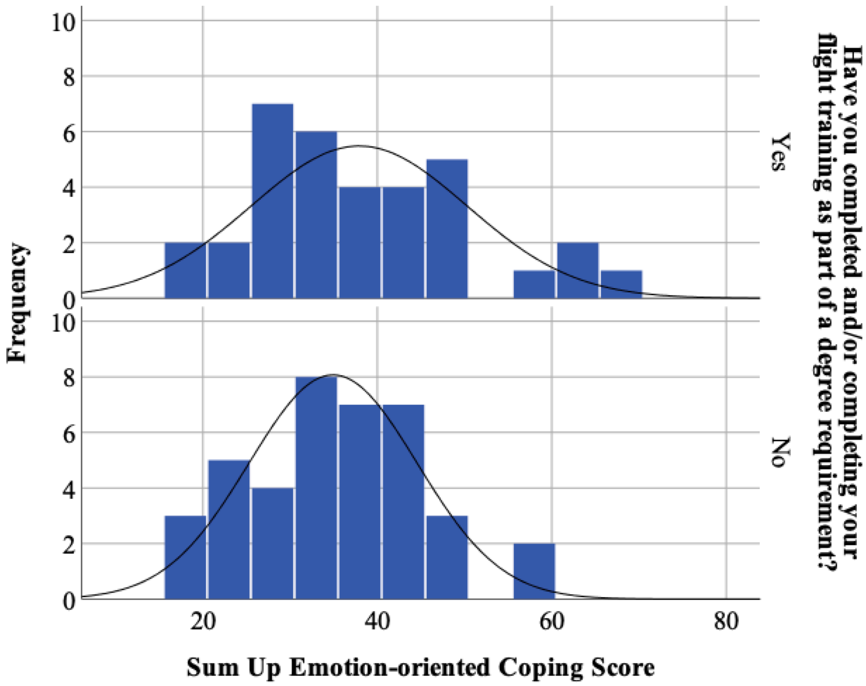


5.3.2.8.4 Comparison of preference for emotion-oriented coping strategies between the non-degree and degree groups

The fourth part of H_7 aimed to examine whether the non-degree and degree students preferred emotion-oriented coping strategies to a similar or different extent. An independent *t*-test was utilised to test for a difference between the groups in their responses to the emotion-oriented coping dimension. There was no statistically significant difference (see Figure 5.24), t (71) = 1.16, p = .25. This suggests that the increased responsibility and workload of university study was not a factor in these students' preference for emotion-oriented coping strategies.

Figure 5.24

Histograms of CISS Emotion-oriented Coping Scores for the Groups of Non-degree (Bottom) and Degree (Top) Students

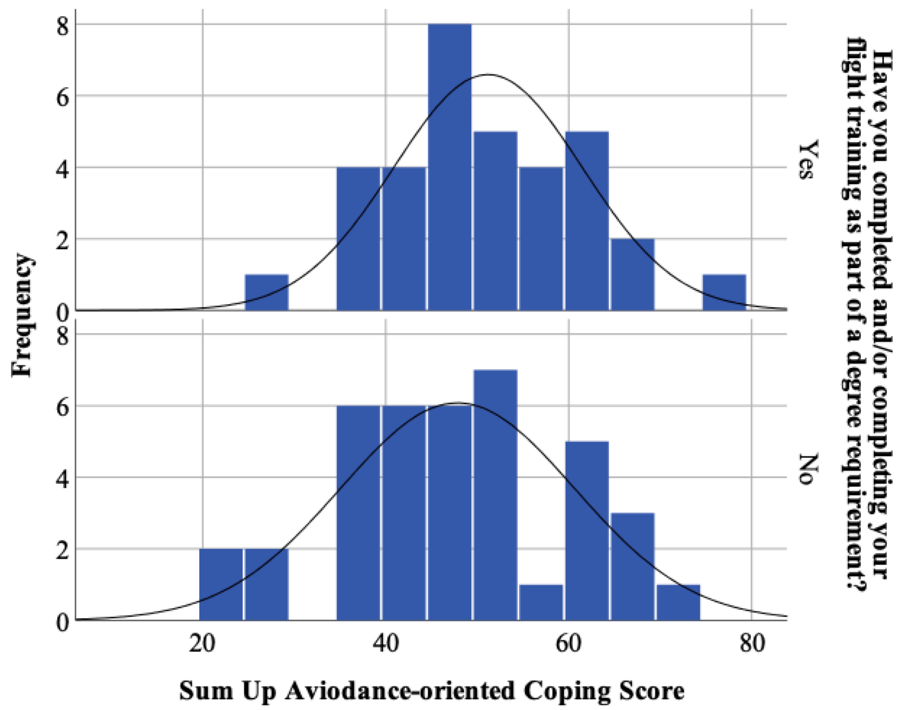


5.3.2.8.5 Comparison of preference for avoidance-oriented coping strategies between the non-degree and degree groups

The final part of H_7 predicted that the two groups of students would have a similar degree of preference for avoidance-oriented coping strategies. An independent *t*-test found no statistically significant difference between the groups in their responses to the avoidance-oriented coping dimension (see Figure 5.25): t (71) = 1.21, p = .23. Thus, pilot students were similar in their preference for coping strategies, whether or not they had completed their flight training as a degree requirement.

Figure 5.25

Histograms of CISS Avoidance-oriented Coping Scores for the Groups of Non-degree (Bottom) and Degree (Top) Students



5.3.2.8.6 H_7 testing summary

In conclusion in regard to H_7, the increased responsibility and workload from completing flight training as a degree requirement might be expected to increase students' stress levels. However, the analyses in this section showed that the degree and non-degree students had similar levels of cognitive flexibility. Furthermore, their stress levels were not related to their preferences for the three coping strategies. The findings wholly validate H_7.

5.3.2.9 Testing H_8

H_8 *In the EFS group, CPL holders are expected to show lower stress levels and higher cognitive flexibility levels, and to prefer task-oriented coping strategies to a greater extent, and emotion- and avoidance-oriented coping strategies to a lesser extent, than students who have not attained their CPL.*

This hypothesis is focused on whether stress levels, cognitive flexibility levels and preferences for task-, emotion- and avoidance-oriented coping strategies differ between post-CPL (n = 27) and pre-CPL (n = 46) students (Table 5.11). The non-parametric Mann–Whitney U test was considered most suitable for testing this hypothesis as the numbers of students in each group were uneven and the sample size of the post-CPL group was less than 30.

Table 5.11

Summary of Scores for Post-CPL and Pre-CPL Students Based on Responses to the PSS, CFI, and Three Coping Dimensions

Survey overall scores / **Participant groups**		**PSS**	**CFI**	**Task**	**Emotion**	**Avoidance**
	Min	0	77	43	18	22
	Max	32	139	78	67	76
	M	13.86	112.74	65.01	36.32	49.40
	SD	5.76	10.98	7.51	11.02	11.74
Post-CPL (***n*** = 27)	Min	6	96	53	19	29
	Max	25	139	78	62	76
	M	14.93	114.85	66.04	36.04	52.37
	SD	4.66	11.02	7.70	11.74	10.89
Pre-CPL (***n*** = 46)	Min	0	77	43	18	22
	Max	32	135	78	67	69
	M	13.24	111.50	64.41	36.48	47.65
	SD	6.28	10.88	7.42	10.71	11.98
Total (73)						

5.3.2.9.1 Comparison of stress levels between the post-CPL and pre-CPL groups

In the first instance, the students' responses to the PSS questionnaire were examined as it was hypothesised that the group of post-CPL students would show lower stress levels than the group of pre-CPL students. A Mann–Whitney U test was performed to test for a difference between these two groups in their level of stress. There was no significant difference in responses to the PSS questionnaire ($U = 506.50$, $z = -1.31$, $p = .19$, $r = -.15$), indicating that aviation students had similar levels of stress whether or not they had already achieved their CPL.

5.3.2.9.2 Comparison of cognitive flexibility levels between the post-CPL and pre-CPL groups

It was hypothesised that the group of post-CPL students would show higher cognitive flexibility than the pre-CPL students. A Mann–Whitney U test was computed on the CFI scores for these two groups to determine if they differed. Although the post-CPL group's mean score was higher than the pre-CPL group, the difference was not significant ($U = 518.00$, $z = -1.18$, $p = .24$, $r = -.14$), suggesting that the two groups had similar degrees of cognitive flexibility.

5.3.2.9.3 Comparison of the preference for task-oriented coping strategies between the post-CPL and pre-CPL groups

It was also hypothesised that the group of post-CPL students would have a higher preference for task-oriented coping strategies than the group of pre-CPL students. To examine this, the CISS task-oriented coping scores for the two groups were compared using a Mann–Whitney U test. The results reveal no significant difference in their responses to the task-oriented coping dimension ($U = 567.50$, $z = -0.61$, $p = .54$, $r = -.07$), suggesting that the groups of post-CPL and pre-CPL students had similar preferences for task-oriented coping strategies when experiencing stressors.

5.3.2.9.4 Comparison of the preference for emotion-oriented coping strategies between the post-CPL and pre-CPL groups

The next part of H_8 predicted that the group of post-CPL students would show a lower preference for emotion-oriented coping methods than the pre-CPL group. A Mann–Whitney U test was used to test for a difference between the two groups in their emotion-oriented coping scores. There was no significant difference in their responses to the emotion-oriented coping dimension (U = 660.00, z = .45, p = .66, r = –.05), which suggests that the students in both groups had a similar preference for emotion-oriented coping strategies when they experienced stress.

5.3.2.9.5 Comparison of the preference for avoidance-oriented coping strategies between the post-CPL and pre-CPL groups

The last part of H_8 predicted that the group of post-CPL students would have a lower preference for avoidance-oriented coping methods than the group of pre-CPL students. The Mann–Whitney U test of a difference between these groups of students' avoidance-oriented coping scores indicated that the group of post-CPL students had a higher mean score for avoidance-oriented coping than the pre-CPL students. However, this difference was not statistically significant (U = 501.00, z = –1.37, p = .17, r = –.16), showing that the student pilots in both groups had a similar preference for avoidance-oriented coping methods when coping with stress.

5.3.2.9.6 H_8 testing summary

In summary, a number of Mann–Whitney U tests were performed to analyse differences between the groups of post-CPL and pre-CPL students in their stress levels and cognitive flexibility levels, and preferences for task-, emotion- and avoidance-oriented coping strategies. The statistical results show that stress levels and cognitive flexibility were similar in both groups even though they differed in flying experience in terms of flying hours. Furthermore, their different level of flying achievement was not associated with their preferred coping methods as both groups had similar preferences for stress coping strategies.

5.3.2.10 Testing H_9

H_9 *Among the EFS pilot group, those with more total flying hours are expected to show lower stress levels and higher cognitive flexibility levels, and to prefer task-oriented coping strategies to a greater extent and emotion- and avoidance-oriented coping strategies to a lesser extent, than those with fewer total flying hours.*

In this part of the hypothesis testing section, the total flying hours (up to the date of data collection) for the 73 student pilots was tested in relation to their stress levels, cognitive flexibility levels and preferred coping methods. The investigation was performed on five dimensions: (1) the students' total flying hours versus their stress levels; (2) the students' total flying hours versus their cognitive flexibility levels; (3) the students' total flying hours versus their preference for task-oriented coping strategies; (4) the students' total flying hours versus their preference for emotion-oriented coping strategies; and (5) the students' total flying hours versus their preference for avoidance-oriented coping strategies.

5.3.2.10.1 Relationship between total flying hours and stress levels

In the first instance, the relationship between the students' total flying hours and their stress levels were examined: it was expected that the more flying experience students obtained, the lower their stress levels would be. A Pearson's correlation test performed on the students' PSS scores and their total flying hours found no evidence of a statistically significant correlation between their total flying hours and stress levels, $r = .15$, $n = 73$, $p = .21$. Indeed, the student pilots with more flying experience had slightly (but non-significantly) higher stress levels than those with less flying experience (see Figure 5.26).

5.3.2.10.2 Relationship between total flying hours and cognitive flexibility levels

Further analysis aimed to assess the relationship between the student pilots' total flying hours and their cognitive flexibility levels. It was predicted that students with more flying experience would have greater cognitive flexibility levels than those with less flying experience. A Pearson's correlation test executed on the students' total flying hours and CFI scores revealed no statistically significant correlation: $r = .11$, n

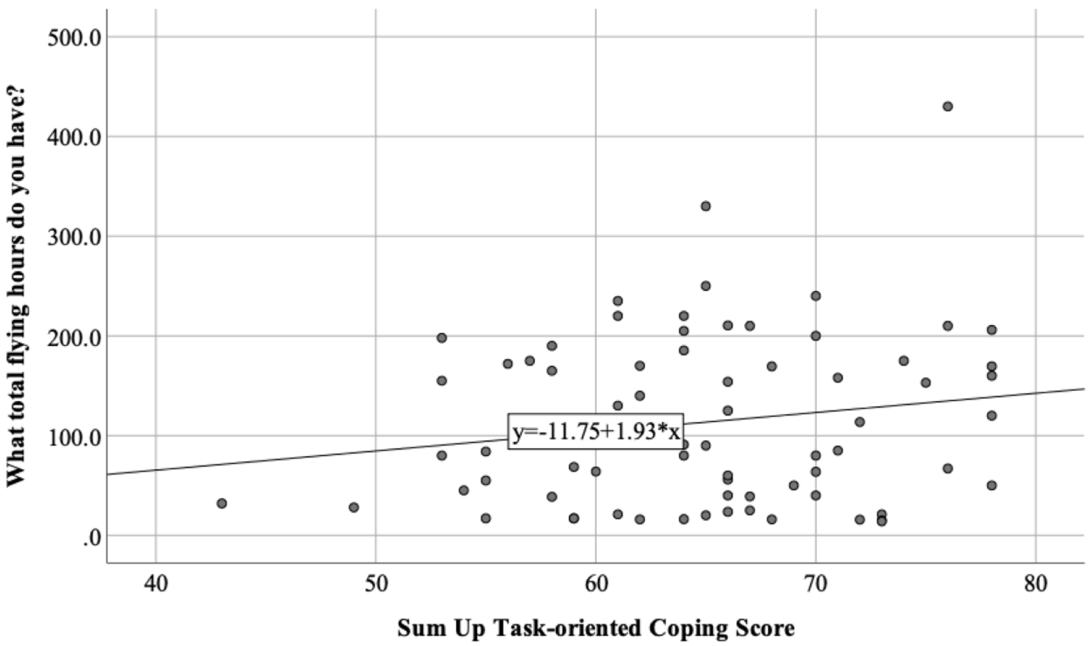
= 73, p = .34. Thus, the students' number of flying hours was not associated with their cognitive flexibility levels: students with few flying hours could be cognitively flexible as well.

5.3.2.10.3 Relationship between total flying hours and preference for task-oriented coping strategies

The third part of H_9 focuses on the relationship between the students' total flying hours and their preference for task-oriented coping strategies. It was expected that students with more flying experience would have a higher preference for task-oriented coping methods. However, a Pearson's correlation test of the students' total flying hours and their CISS task-oriented coping scores found no statistically significant correlation between their total flying hours and the degree they adopted the task-oriented coping strategies: r = .17, n = 73, p = .15. There was only a weak positive relationship (see Figure 5.27) with students with more flying experience showing a slightly higher preference for this coping method than students with less flying experience.

Figure 5.27

Scatterplot Displaying the Relationship Between Students' Total Flying Hours and CISS Task-oriented Coping Scores



5.3.2.10.4 Relationship between total flying hours and preference for emotion-oriented coping strategies

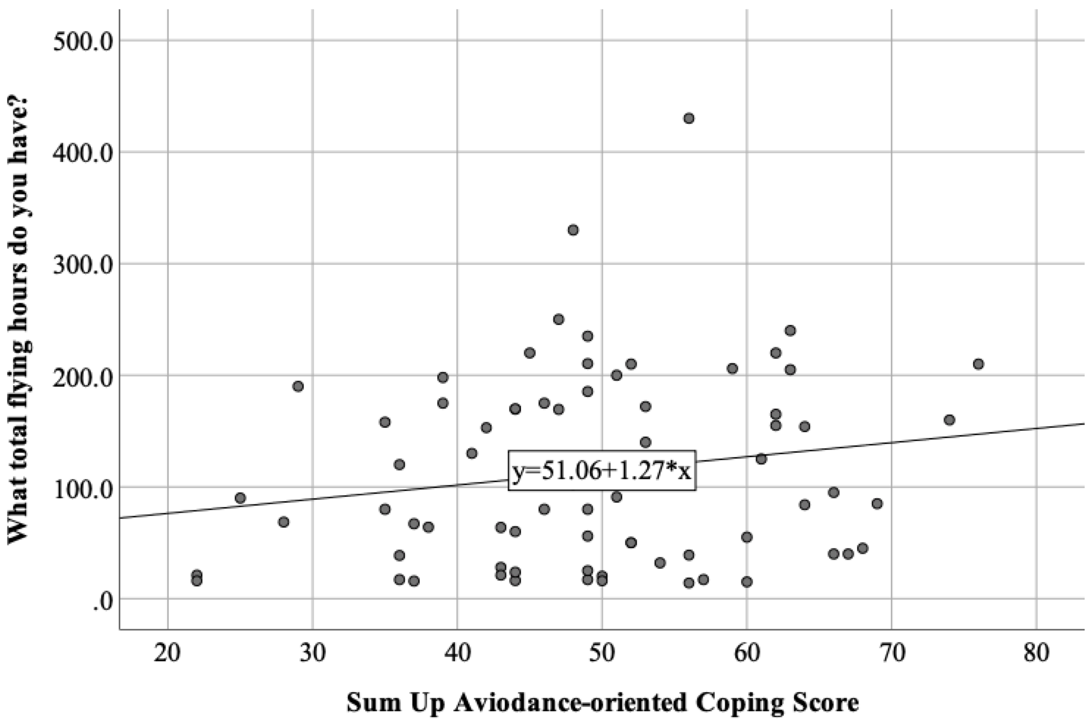
The next part of H_9 is concerned with the relationship between the students' total flying hours and their preference for emotion-oriented coping strategies. It was predicted that students with more flying experience would have a lower preference for this type of coping strategy. A Pearson's correlation test of the students' total flying hours and their CISS emotion-oriented coping scores indicated that there was no statistically significant correlation between students' total flying hours and preference for emotion-oriented coping strategies: $r = .02$, $n = 73$, $p = .86$. Students' preferences for emotion-oriented coping strategies when they experience stress were independent of their level of flying experience.

5.3.2.10.5 Relationship between total flying hours and preference for avoidance-oriented coping strategies

The last part of H_9 focuses on the relationship between the students' total flying hours and their preference for avoidance-oriented coping strategies. It was predicted that students with more flying experience would have a lower preference for avoidance-oriented coping methods. The final Pearson's correlation test was executed on the students' total flying hours and their use of the CISS avoidance-oriented coping methods. The result was not statistically significant, $r = .17$, $n = 73$, $p = .14$, although students with more flying experience had a slightly higher preference for avoidance-oriented coping strategies than students with less flying experience (see Figure 5.28).

Figure 5.28

Scatterplot Displaying the Relationship Between Students' Total Flying Hours and CISS Avoidance-oriented Coping Scores



5.3.2.10.6 H_9 testing summary

In conclusion, the statistical analyses in relation to H_9 found no evidence of strong correlations between students' flying experiences and their stress levels, cognitive flexibility levels and preferences for coping methods. However, some weak relationships were revealed regarding students' flying experiences and their stress levels, as well as their preferences for task- and avoidance-oriented coping strategies. Interestingly, students with more flying experience showed slightly higher stress levels and a slightly higher preference for avoidance-oriented coping strategies, contrary to expectation.

5.3.2.11 Testing H_{10}

H_{10} *Among the EFS pilot group, those who have failed major tests/exams are expected to show higher stress scores and lower cognitive flexibility levels, and to prefer task-oriented coping strategies to a lesser extent and emotion- and avoidance-oriented coping strategies to a greater extent, than the group who have never failed any tests/exams.*

The last hypothesis in this study examined differences between the group of students who had never failed any major tests/exams (the non-failing group) and the group who had failed some major tests/exams (failing group), in regard to stress levels, cognitive flexibility levels and preferences for the three coping strategies. The 73 student pilots were divided into two groups: 34 students (46.6%) in the failing group and 39 students (53.4%) in the non-failing group (see Table 5.12).

Table 5.12

Summary of Scores for Non-failing and Failing Students Based on Responses to the PSS, CFI, and Three Coping Dimensions

Survey overall scores / **Participant group**		**PSS**	**CFI**	**Task**	**Emotion**	**Avoidance**
	Min	0	77	43	18	22
	Max	32	139	78	67	76
	M	13.86	112.74	65.01	36.32	49.40
	SD	5.76	10.98	7.51	11.02	11.74
Non-failing group (*n* = 39)	Min	0	88	49	18	22
	Max	26	135	78	62	76
	M	12.85	111.85	65.15	35.67	46.41
	SD	6.12	9.70	6.98	11.72	12.26
Failing group (*n* = 34)	Min	6	77	43	19	29
	Max	32	139	78	67	74
	M	15.03	113.76	64.85	37.06	52.82
	SD	5.16	12.35	8.18	10.29	10.25
Total (73)						

5.3.2.11.1 Comparison of stress levels between the non-failing and failing groups

The first part of H_{10} predicted that the group of failing students would show higher stress levels than the group of non-failing students. An independent *t*-test was performed to test for a significant difference between the groups in their PSS scores. The results indicate that the failing group's mean score was slightly but not significantly higher than that of the non-failing group: t (71) = 1.63, p = .11. Thus, the group of non-failing students and the group of failing students had a similar degree of stress.

5.3.2.11.2 Comparison of cognitive flexibility levels between the non-failing and failing groups

The next part of H_{10} predicted that the group of failing students would have lower cognitive flexibility levels than the group of non-failing students. An independent *t*-test was computed to test for a difference in CFI scores between the groups; no significant different was found: t (71) = .74, p = .46.

5.3.2.11.3 Comparison of preference for task-oriented coping strategies stress levels between the non-failing and failing groups

The third part of H_{10} predicted that failing students would show a lower preference for task-oriented coping strategies than non-failing students. An independent *t*-test was performed to compare these two groups' the CISS task-oriented coping scores, finding no evidence of a difference: t (71) = –.17, p = .87. Both groups had a similar preference for task-oriented coping strategies when preparing for major tests/exams and their failure could be due to other factors.

5.3.2.11.4 Comparison of preference for emotion-oriented coping strategies stress levels between the non-failing and failing groups

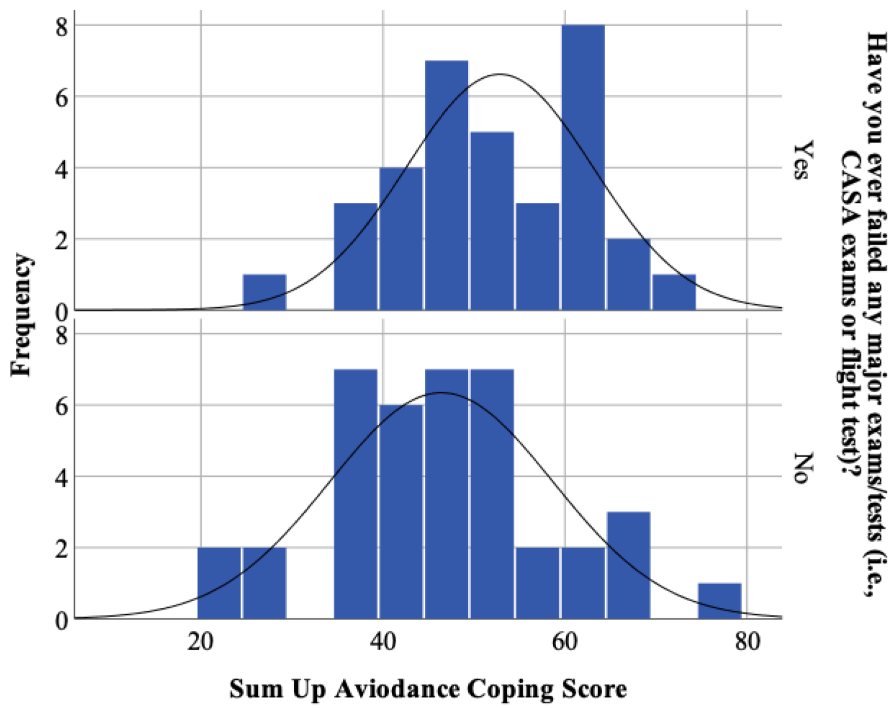
Part of H_{10} predicted that the group of failing students would have a higher preference for emotion-oriented coping methods than the group of non-failing students. An independent *t*-test of the difference in these groups' CISS emotion-oriented coping was not significant: t (71) = .54, p = .59. Thus, these groups had similar preferences for emotion-oriented coping methods when encountering stress.

5.3.2.11.5 Comparison of preference for avoidance-oriented coping strategies stress levels between the non-failing and failing groups

The final test of H_{10} examined the hypothesis that failing students would have a higher preference for avoidance-oriented coping methods than non-failing students. A final independent *t*-test (Figure 5.29) indicated a strong and significant difference between these two groups in their responses to the CISS avoidance-oriented coping dimension: t (71) = 2.40, p = .019. The group of failing students had a significantly higher preference for avoidance-oriented coping strategies than the group of non-failing students when dealing with stressors.

Figure 5.29

Histograms of CISS Avoidance-oriented Coping Scores for the Groups of Failing (Top) and Non-failing (Bottom) Students



A battery of independent *t*-tests in relation to the last hypothesis evaluated the non-failing and the failing groups' responses to the PSS, the CFI and the CISS task-oriented coping, emotion-oriented coping, and avoidance-oriented coping dimensions. There was no statistical evidence that these groups differed in their stress levels or cognitive flexibility levels. Further, there was no evidence that the non-failing group had a higher preference for task-oriented coping strategies or lower preference for emotion-oriented coping strategies than the failing group. However, the statistical evidence clearly indicates that the failing group had a stronger preference for avoidance-oriented coping strategies than the non-failing group, which may be why they have failed some of their assessments.

5.4 Discussion

Study 2 evaluated the level of cognitive flexibility and the preference for coping strategies associated with particular stress levels in the group of aviation students experiencing the same types of stressors. The results indicate that the level of cognitive flexibility and preference of students for the three coping strategies were associated with their stress levels in different ways. A summary of the findings is provided in Table 5.13 and Figure 5.30. Furthermore, demographic variables including whether or not the students were experienced with flying, their age, gender, workload, total hours before their first solo check, whether or not they had attained their CPL and their total flying hours were associated in different ways with their stress levels and cognitive flexibility as resilience factors. A summary of the hypothesis testings is provided in Table 5.14. The outcomes of this study are expected to be useful regarding why these two resilience factors are considered supportive/protective factors for pilots. Additionally, the findings can be used to guide future aviation students in regard to what resilience factors they should focus on learning to improve their resilience capability for a safer outcome when working in the high-risk environment of the aviation industry.

Table 5.13

Summary of Correlations Between Factors for the Group of Aviation Students

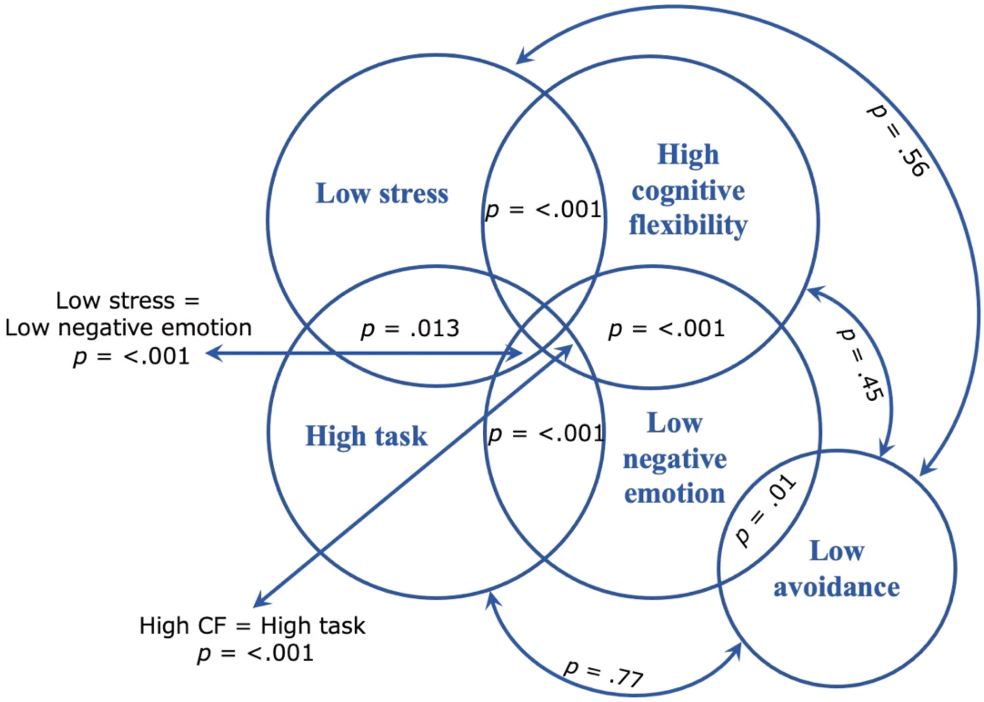
Factor pair	Correlation
Stress v. cognitive flexibility	Negative
Stress v. task-oriented coping strategies	Negative
Stress v. emotion-oriented coping strategies	Positive
Stress v. avoidance-oriented coping strategies	No
Cognitive flexibility v. task-oriented coping strategies	Positive
Cognitive flexibility v. emotion-oriented coping strategies	Negative
Cognitive flexibility v. avoidance-oriented coping strategies	No
Task-oriented coping strategies v. emotion-oriented coping strategies	Negative
Task-oriented coping strategies v. avoidance-oriented coping strategies	No
Emotion-oriented coping strategies v. avoidance-oriented coping strategies	Positive

5.4.1 Correlation Between Cognitive Flexibility, Preference for the Three Coping Strategies and Stress

The survey study on the group of aviation students showed that their level of stress was correlated with their cognitive flexibility levels and their preferred type of coping method. The results support H_1, in that those students who demonstrated a high level of cognitive flexibility—for example, those who answered that they strongly agreed that when they encountered a difficult situation, they stopped and tried to think of several ways to resolve it—experienced a moderate level of stress whether the stressors was pressure from flight training or a high academic workload. This finding agrees with those of Campbell-Sills et al. (2006) and Southwick and Charney (2012) that cognitive flexibility helps to reframe adversity and stressful events in a more positive light, and can moderate the severity of distress because having more flexible thinking and expanded behavioural options increases the personal resources of the resilient individual.

Figure 5.30

Identified Relationships Between Stress, Cognitive Flexibility, and Three Coping Strategies for the Participating Aviation Students



The hypothesis that highly cognitively flexible students would have lower stress levels because they adopted more task-oriented coping methods such as 'make an extra effort to get things done' or 'use the situation to prove that they could do it' to cope with stress is also supported by statistical analysis. The same was found in the studies of Asici and Halil (2021), and Johnson (2016) where the level of cognitive flexibility could predict adaptive or maladaptive coping styles. It seems that this type of coping strategy can address stressors before stress builds up to a critical point because of these aviation students' self-belief that they have the ability to control any hardships in their life. Southwick et al. (2005) state that the ability to cognitively reappraise, reframe or have a sense of control over stressors makes an individual believe they can effectively deal with a problem through active problem solving. Moos and Schaefer (1993) also describe resilient individuals s those who use active coping mechanisms such as seeking social support and adopting a fighting spirit to deal with a stressful situation. Southwick et al. (2014) believe that the qualities of a person alone are not sufficient to predict resilience; more importantly, promoting healthy environments and social support will foster the individual's natural protective systems to develop and operate effectively when in an encounter with stressors. When the aviation students showed high cognitive flexibility levels as well as greater adoption of task-oriented coping strategies, they exhibited positive signs of being resilient. This characteristic appears when one has the flexibility in thinking and shows the capability to select coping methods that are suitable for a situation that is difficult to cope with comfortably, to reduce their stress.

The students with lower cognitive flexibility adopted more emotion-oriented coping methods that involved negative emotions (e.g., feeling anxious about not being able to cope, becoming very upset, using self-blame or negative self-talk); this group also showed a preference for avoidance coping strategies. This may be explained by the students with high emotion-oriented scores expressing a greater level of negative emotions or employing a more passive coping style, which results in them trying to divert their attention from stress by using avoidance-oriented coping methods such as taking time off and getting away from the situation or trying to be with other people to avoid having to cope effectively with stress.

Lazarus (1991) explains that appraisal generates a different form of emotion, whether positive or negative, which can prompt the response to fight or flee. Emotions can be said to determine what coping strategies an individual adopts in response to different stressors. Therefore, when the aviation students returned high emotion-oriented coping scores in response to the CISS questionnaire, they appeared to use more distancing and avoiding coping methods to counter stress. In contrast, students who reported low preference for emotion-oriented coping methods did not mean they did not use their emotions to cope with stress; rather, they used positive emotions to allow themselves to stay calm during their distress. Some researchers (Folkman, 1984; Lazarus, 1966; Maloney et al., 2014) believe that the effectiveness of problem-focused coping depends largely on emotion coping efforts by creating a positive meaning through reframing.

Surprisingly, the findings for this group led to rejection of one part of the hypothesis that high task-oriented individuals would show a lower preference for avoidance-oriented coping strategies. The inferential statistical analysis results suggest that the aviation students had a similar preference for both these strategies whether or not they had experience in flying. The descriptive statistics also show that the largest proportion of aviation students (n = 59, 48.0%) preferred avoidance-oriented coping strategies more than their peer.

Several research studies (Bartone et al., 2017; Blalock & Joiner, 2000; Healy & Mckay, 2000; Holahan et al., 2005; Koeske et al., 1993) showed that avoidance coping is a maladaptive coping style and always had negative outcomes when an individual overused this coping method. However, researchers studying 'approach–avoidance' theory (Carver, 2011; Lazarus, 1983; Roth & Cohen, 1986) suggest that minimal use of avoidance can provide some hope and courage when confronting prolonged stressors and help to lessen stress and anxiety during the time needed to assimilate stressful information and mobilise efforts to change the environment or provide protection. The short-term diversion from stress allows some time to rest and think of how to embark upon other tasks. Roth and Cohen (1986) also point out that avoidance is a better strategy to be utilised than approach if the situation appears uncontrollable, but approach appears better if one potentially has control over the situation.

When 'approach–avoidance' theory is applied to aviation students attempting to achieve their university degree and/or flight training, it can be explained that some students with a high preference for task-oriented coping methods might also adopt avoidance coping methods such as getting snacks or going out for a walk to provide a brief diversion from stress (e.g., when preparing for an exam or flight test). Nevertheless, if students utilise avoidance coping methods excessively, such as by attending parties or watching TV every day to avoid preparing for their tests, this often results in the negative outcome of failing the test, which heightens their stress levels even further. Carver (2011) suggests that in the long term, avoidance coping strategies become ineffective when a stressor is a real threat that one has to eventually confront.

In conclusion, the results of this study show that the aviation students with high cognitive flexibility used a combination of task- and avoidance-oriented coping (though not excessively) to cope with stressors and prevent them becoming overwhelmed by stress. Additionally, while the group of students with a high preference for task-oriented coping methods may have adopted avoidance coping strategies in the short term to allow themselves to stay calm and achieve a brief diversion from stress, they did not allow negative emotions to influence their coping process; that is, they adopted emotion-oriented coping methods to a low degree. The group of students displaying more negative emotions was likely to have a higher preference for avoidance coping methods; hence they experienced an increase in their stress levels as this strategy prolonged their encounters with stressors.

5.4.2 Comparison Between the Groups of EFS and NFS

The significant results from the inferential statistics show that the group of EFS displayed a higher level of resilience than the group of NFS; thus, it might be concluded that flight training can strengthen this capability. The statistical analysis results for H_4 clearly show that the group of EFS had higher cognitive flexibility levels, lower stress levels, higher preference for task-oriented coping strategies and lower higher preference for emotion-oriented coping strategies than the NFS group, although both groups showed a similar preference for avoidance coping strategies.

Currently, there is no scientific literature to explain how flight training might modify student pilots' stress levels or cognitive flexibility levels or alter their preferred type of coping method to differentiate their resilience capability from that of students who have not had the experience of flying. The literature (Feder et al., 2010; Rutter, 1993; Southwick and Charney, 2012) shows that 'stress inoculation' is a key concept that may explain this phenomenon given that an unavoidable aspect of flight training is that student pilots regularly encounter several types of setbacks or unexpected event. Throughout the practice course, in addition to overcoming the difficulties of learning to fly—for example, students have to quickly expand their learning capacity by attempting their first solo flight or passing licence tests as fast as they can to save on costs—they also have to improve their mental toughness to withstand psychological stressors when things do not go to plan. Accordingly, when stressors are inoculated during this development process, students who endure flight training are likely to broaden their resilience capacity, improve their cognitive flexibility and develop adaptive coping strategies suitable for dealing with various types of stressors that may arise in their future career in the aviation industry.

Table 5.14

Aviation Student Group Hypothesis Testing Result Summary

Hypothesis		***Stress***	***CF***	***Task***	***Emotion***	***Avoidance***
H_4	EFS *v.* NFS	EFS lower; *p* = .017	EFS higher; *p* = .002	EFS higher *p* = <.001	EFS lower; *p* = .003	*p* = .80
H_5	Young *v.* older	*p* = .67	*p* = .28	Older higher; *p* = .017	*p* = .60	*p* = .16
H_6	Male *v.* female	Weak difference: female higher; *p* = .10	*p* = .56	*p* = .64	*p* = .38	*p* = .77
H_7	Degree *v.* non-degree	Degree higher; *p* = .03	*p* = .50	*p* = .70	*p* = .25	*p* = .23
H_8	Post-CPL *v.* pre-CPL	Weak difference: post-CPL higher; *p* = .19	*p* = .24	*p* = .54	*p* = .66	Weak difference: post-CPL higher; *p* = .17
H_9	Total hours	*p* = .21	*p* = .34	Weak difference: more hours more task; *p* = .15	*p* = .86	Weak difference: more hours more avoidance; *p* = .14
H_{10}	Failing *v.* non-failing	Weak difference: failing higher; *p* = .11	*p* = .46	*p* = .87	*p* = .59	Failing higher; *p* = .019

Meichenbaum (2017) and Stetz et al. (2007) suggest that controlled exposure to stress-related cues is a key feature of resiliency training, especially for people who work in conditions where performance in the face of adversity is required. From the current researcher’s point of view, this development process may be important for improving aviation students’ resilience capability even before they proceed to the flying school, so that they learn a more adaptive response to stress that might increase their endurance for tolerating the hardships of a flying career. By focusing on this process, students might be inoculated with a resilient mindset and prepared to go face any adversities they might experience in their future as a pilot.

5.4.3 The Role of Age

The findings in regard to H_5 show that increasing age did not alter the level of stress, cognitive flexibility or preference for emotion and avoidance coping strategies among the aviation students. This might be because the common stressors aviation students confronted during the time of this data collection generally came from their university workload and flight training, One exception was that the older students had a higher preference for task-oriented coping strategies than the young students. A similar result was found in a study by Gillespie et al. (2009) when OR nurses' resilience capability was influenced by years of OR experience rather than their age or education level. Studies by Beutel et al. (2009) and Lamond et al. (2008) on women of different ages also found that age was not a significant factor in resilience ability.

Although some researchers (Bonanno et al., 2007; Kruczek et al., 2020; Leipold et al., 2019) suggest that resilience levels vary with age because adversity or life experiences can improve this ability, they do not generalise about the age at which resilience improves. Resilience capability might be broadened only when people experience setbacks so that they can attempt to withstand and thrive from those adverse events. For example, 18-year-old students would be as resilient as 34-year-old students if they learned to fly at the same time as they would experience the same types of stressors. Considering that aviation students are exposed to similar types of stressors that cause them a similar level of stress, older students may put extra effort into eliminating stress by adopting more task-oriented coping methods, which is considered an attribute of the resilient individual. Additionally, the findings from Study 1 include that age is not a factor in level of resilience; rather, resilience is more likely to be determined by other factors. Thus, age is a significant factor in both aviation student and pilot resilience.

5.4.4 The Role of Gender

Davis et al. (2011) advises that when comparing stress levels or coping method preferences between males and females, the type of stressor under study is highly relevant. In the current study, although female aviation students had higher mean scores for all measured factors—that is, how they perceived stress, their cognitive flexibility levels; their preference for coping strategies, and whether or not they had flying experience—none of these differences were significant in statistical analyses.

Numerous studies (Bore et al., 2016; Cohen & Janicki-Deverts, 2012; Nolen-Hoeksema, 1987; Rahimi et al., 2014) show that females typically perceive distress or stress at a higher level than males in most cases. Although the findings in this study tend to support those of these previous research studies, the statistical analyses did not detect any differences between the genders' mean PSS scores (female $M = 16.55$ *v.* males $M = 14.45$, $p = .11$). This may represent Type II error due to the sample sizes of the male ($n = 94$) and the female ($n = 29$) groups being very different, or the small female sample size per se. Thus, it may be that the female aviation students did in fact perceive a higher level of stress than the male aviation students but that a larger sample size is required in future studies in the aviation context to examine this issue further.

With regard to the preferred coping methods of male and female aviation students, this study agreed with a quantitative review of 50 studies by Tamres et al. (2002) that females prefer a wider variety of coping strategies than males when coping with stress. The female students in the current study had higher mean scores for both task- and emotion-oriented coping strategies than the male students although these differences were not significant; again, this might be due to Type II error caused by the small female sample size.

5.4.5 Comparison Between Degree and Non-degree Students

The increased responsibility and workload from attempting to complete a university degree raised aviation students' stress levels compared with students who attempt to finish flight training only. Nevertheless, it did not influence their cognitive flexibility or preference for different coping strategies. The inferential statistical results show that the group of degree students had mean stress levels higher than the non-degree students. However, only one degree student had a high stress score (see Figure 5.21); the others had average or low stress scores. This individual had average cognitive flexibility levels, and low preference for task-oriented coping but high for emotion- and avoidance-oriented coping strategies. They also flew their first solo after 20 hours of flying experience and had failed two major exams and achieved a total of 32 hours of flying at the time of data collection. This case may suggest that when a person has a low level of cognitive flexibility, they follow the natural instinct to utilise high emotion-oriented coping methods, which leads to less engagement in adaptive coping (task-oriented coping) and more engagement of maladaptive coping (avoidance-oriented coping). When the moderator is not effective or sufficient, then a negative outcome such as failing exams may result.

Smith and Kirby (2011) suggest that when stress is seen as a challenge rather than a threat, the individual focuses on the potential for gain or growth in the situation. The degree students may have perceived the stress of attempting to attain a university degree at the same time as earning a flying licence as a challenge, thus expanding their behavioural repertoire to overcome these stressful but challenging tasks. Martin and Rubin (1995) and Martin and Anderson (1998) explain that cognitively flexible people are more likely to recognise possible behavioural adjustments based on situational factors and are thus more willing to try new ways of encountering unfamiliar situations and adapt their behaviours to meet contextual needs. This may explain why the increased stress from a higher workload and responsibility did not alter the degree students with high cognitive flexibility, as these students had developed a wide range of coping strategies to support them to overcome any hardships.

5.4.6 Comparison Between the Post-CPL and Pre-CPL Groups

The statistical results in relation to H_8 show that the post-CPL group scored slightly higher on their stress levels, cognitive flexibility levels and preference for avoidance-oriented coping strategies, but the two groups had similar level of preferences for task- and emotion-oriented coping strategies. Although the post-CPL student pilots scored slightly higher than the pre-CPL student pilots in stress, cognitive flexibility, and avoidance coping strategies; however, inferential statistical test results show that none of these factors was significant in this study. Therefore, it is yet to be determined whether post-CPL aviation students have lower perceived stress levels, higher cognitive flexibility levels, a higher preference for task-oriented coping, and lower preference for emotion- and avoidance-oriented coping strategies.

One potential cause of the ambiguous results in relation to this hypothesis is that the sample size for this analysis (total n = 73) was too small for inferential statistical tests to detect small differences between groups, which may have resulted in a Type II. If the maximum acceptable chance of making a Type II error is 0.20% (Hanna and Dempster, 2012), thus, assuming that these differences were real. Based on the p values, it can be concluded here that the post-CPL students had higher stress levels and higher preference for avoidance-oriented coping strategies than the pre-CPL students but that the two groups had similar cognitive flexibility levels preferences for task- and emotion-oriented coping strategies.

For post-CPL students to have higher stress levels and preference for avoidance-oriented coping strategies than the pre-CPL students were unexpected. It may be driven by the higher expectations and intense workload in meeting licence requirements as well as the length of time post-CPL students had felt under pressure and stress. This may have prompted them to employ avoidance-oriented coping methods at a higher level than pre-CPL students to divert themselves from stressors, which could help them remain calm in the short term when encountering hardships.

5.4.7 Effect of Number of Hours of Flying Experience

The comparison of number of total flying hours for student pilots, taking into account the potential for Type II error, suggests that more flying experience did not lessen stress levels or increase cognitive flexibility levels; nor did it reduce the adoption of emotion-oriented coping methods. Nevertheless, the more the flying experience, the more the student pilots preferred task-oriented coping, which was expected under H_9. Surprisingly, students with a higher preference for task-oriented coping also had a higher preference for avoidance-oriented coping strategies.

It can be interpreted that more flying experience can promote the use of more adaptive coping methods (task-oriented coping) in the face of stress, as students with more flying experience put more effort into dealing with the hardships of flight training. Boerner and Jopp (2010) suggest that people remain resilient when they make active efforts towards problem solving that aim to control their internal adjustments and improve or bring an end to an adverse situation. However, over the extended period of stress involved in flight training, focusing solely on task-oriented coping can intensify stress levels. Indeed, Roth and Cohen (1986) suggest that orientation towards a threatening situation can lead to increased distress and non-productive worry. Therefore, students with more flying experience may have adopted avoidance coping as a short-term diversion from the extended stressful period of flight training. Up to this point in the discussion, the findings in this study makes the researcher agrees with many other researchers (Carver, 2011; Lazarus, 1983; Roth & Cohen, 1986) that minimal use of avoidance coping can be useful in the short term; however, excessive use of this type of coping method always has negative outcomes as shown in the next section.

5.4.8 Comparison Between Non-failing and Failing Groups

This study found that the students who had failed some major tests/exams did not have significantly higher stress levels than those who had not. They also had a significantly higher preference for avoidance-oriented coping strategies than their non-failing peers. However, there were no significant differences found between these two groups in cognitive flexibility preference for task- and emotion-oriented coping strategies. This may be because the group of failing students used avoidance coping methods to postpone dealing with the stress of upcoming tests/exams, and thus had less time to prepare for the tests. This is a significant effect leading to failing tests/exams when some students utilise avoidance coping methods for the event that required highly engagement in task-oriented coping strategies to overcome stress or hardship.

Carver (2011) suggests that some stressors become more difficult and urgent to deal with if avoided for too long. This may explain why students who adopted a higher level of avoidance coping methods in this study had a higher chance of failing tests/exams; that is, they may have spent more time procrastinating and less time preparing, yet failure did not cause excessive stress levels, reduce cognitive flexibility levels, or provoke negative emotions. This group of students maintained their resilience ability to some level and still pursued flight training despite failing major assessments. It is recommended that students who fail major exams should adopt a higher degree of task-oriented coping methods to overcome their avoidance coping behaviour so that they have a higher success rate with their tests/exams.

5.5 Chapter Summary

From the findings in this chapter, it can be summarised that the students who exhibited higher levels of cognitive flexibility and higher preference for task-oriented coping strategies experienced lower stress levels. Conversely, students who displayed a lower level of cognitive flexibility and higher preference for emotion-oriented coping strategies appeared to perceive higher levels of stress. However, the results from this study indicate that the extent to which the students engaged in avoidance-oriented coping strategies did not determine their cognitive flexibility levels, stress levels or preference for task-oriented coping strategies. Students who adopted a greater degree of emotion-oriented coping methods appeared to utilise avoidance coping methods to a greater extent.

Additionally, experience in flying had the greatest influence on student resilience: the EFS group appeared to show higher levels of cognitive flexibility and higher preferences for task-oriented coping methods. However, the EFS group engaged to a lesser degree in emotion-oriented coping methods, resulting in lower stress levels compared with the NFS group. In addition, student pilots demonstrating a higher level of cognitive flexibility underwent their first solo check and gained their CPL licence with fewer hours than those with lower levels of cognitive flexibility. Older students appeared to prefer task-oriented coping strategies and underwent their first solo check with fewer hours than younger students. It was also found that student pilots with more flying hours had a higher preference for task-oriented coping methods.

The research findings in this chapter suggest that to promote resilience capability in aviation students, the enhancement of cognitive flexibility and adaptive coping styles—which include positive emotion- and task-oriented coping strategies—is critical. Improvements in these two resilience capabilities can greatly promote students' success when they commence flight training, which can give rise to the resilient pilots of the future.

CHAPTER 6: DISCUSSION

This thesis examined whether cognitive flexibility and use of active coping strategies influence pilots' stress levels. Two studies measured differences in resilience levels among (1) professional airline pilots, and (2) student pilots and aviation students with no flying experience. The findings indicate that different levels of cognitive flexibility prompt adaptive and maladaptive coping styles in both airline pilots and aviation students (see Figure 6.1). However, higher levels of cognitive flexibility and engagement in adaptive coping reduce stress levels only in aviation students, not airline pilots. The findings also indicate that the professional airline pilots have higher cognitive flexibility levels and preference for adaptive coping styles and adopt maladaptive coping styles to a lesser degree than do aviation students (see Table 6.1). In addition, this research shows that factors such as working more hours yearly, flying experience and age affect the level of resilience to varying degrees, as discussed in the following section.

Figure 6.1

Comparison of Results for the Airline Pilots and Aviation Students

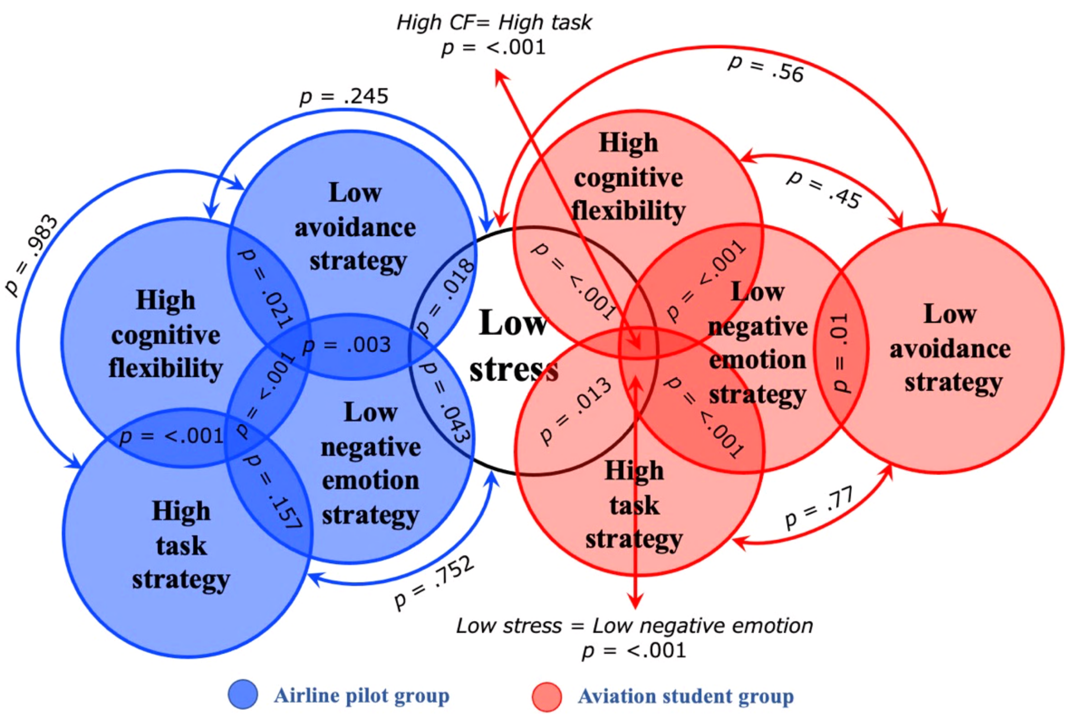


Table 6.1

Comparison of Scores Between the Groups of Airline Pilots, EFS and NFS

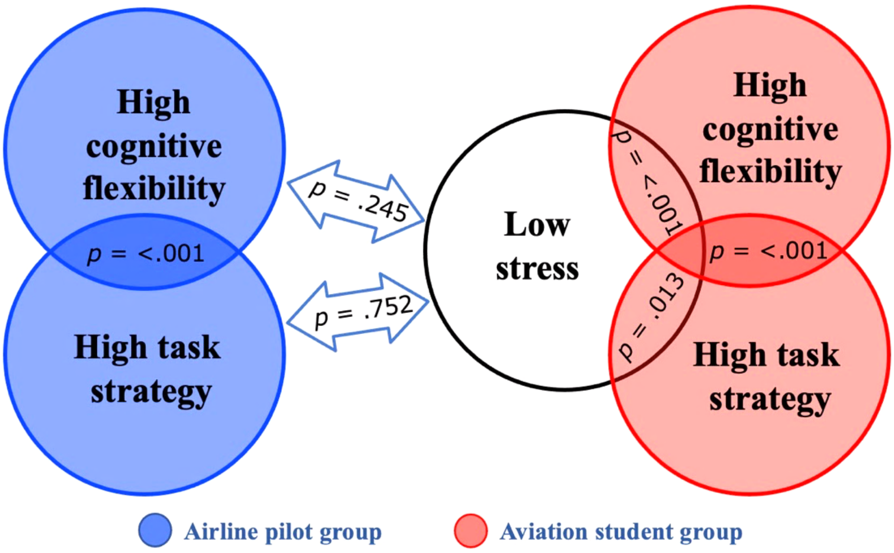
Group of Participants	%	Possible Range of Scores	Observed Range of Scores	*M*	*SD*
Cognitive flexibility					
Airline pilot group (*n* = 77)	100%	20 – 140	88 – 135	117.12	10.00
EFS group (*n* = 73)	100%	20 – 140	77 – 139	112.74	10.98
NFS group (*n* = 50)	100%	20 – 140	77 – 128	106.16	11.44
Task-oriented coping dimension					
Airline pilot group (*n* = 77)	100%	16 – 80	48 – 79	65.47	6.81
EFS group (*n* = 73)	100%	16 – 80	43 – 78	65.01	7.51
NFS group (*n* = 50)	100%	16 – 80	32 – 76	57.86	8.50
Emotion-oriented coping dimension					
Airline pilot group (*n* = 77)	100%	16 – 80	17 – 62	34.97	10.03
EFS group (*n* = 73)	100%	16 – 80	18 – 67	36.32	11.02
NFS group (*n* = 50)	100%	16 – 80	18 – 67	42.64	11.50
Avoidance-oriented coping dimension					
Airline pilot group (*n* = 77)	100%	16 – 80	17 – 70	43.17	10.48
EFS group (*n* = 73)	100%	16 – 80	22 – 76	49.40	11.74
NFS group (*n* = 50)	100%	16 – 80	25 – 69	49.94	10.70

6.1 Stress Versus Cognitive Flexibility Versus Task-oriented Coping Strategies

Comparison of factors between the groups of airline pilots and aviation students revealed that cognitive flexibility and preference for task-oriented coping strategies were negatively correlated with stress levels in aviation students but not in airline pilots (see Figure 6.2). However, airline pilots' cognitive flexibility levels and preference for task-oriented coping strategies were higher than those for both the EFS and NFS groups.

Figure 6.2

Comparison Between the Airline Pilot and Aviation Student Groups in Identified Relationships Between Stress, Cognitive Flexibility and Task-oriented Coping Strategies



The results from the two studies show that individuals with higher cognitive flexibility engaged in more task-oriented coping strategies, which corresponds with the findings of previous studies (Asici & Sari, 2021; Dennis & Vander Wal, 2009; Johnson, 2016; Yakhnick & Ben-Zur, 2008). Cognitive flexibility (Campbell-Sills et al., 2006; Genet & Siemer, 2011; Southwick and Charney, 2012) and task-oriented coping strategies (Anthony, 1987; Kumpfer, 2002; Smith et al., 2016) are indicated to be constructs of trait resilience. Accordingly, individuals who show greater capacity to be cognitively flexible and a higher preference for task-oriented coping strategies when dealing with stressful demands are predicted to be more resilient than those with lower levels of these capabilities.

Study 1 on the group of airline pilots identified that high cognitively flexible airline pilots have sufficient capacity to cope with highly stressful demands without any effect on their stress levels; this ability can help in avoiding adverse events or accidents while operating an aircraft. This finding concurs with Hildebrandt et al. (2016) in implying that cognitive flexibility is potentially critical in a threatening situation where cognitive processes need to be inhibited and resources shifted to processing the current threat. Southwick and Charney (2012) suggest that a high level of cognitive flexibility helps an individual to reframe stressful situations into more positive prospects, which in turn assists in moderating the severity of distress. Genet and Siemer (2011) also point out that the resilient individual is one who can show s greater adaptive response to change in threatening situations. This ability supports the individual to improve their flexibility in attending to and disengaging from emotional material. From this perspective, it can be concluded that cognitive flexibility is one of the resilience factors that supports pilots when working under stressful conditions. Furthermore, aviation students with high levels of cognitive flexibility are expected to acquire greater resilience capability, which is a predictor of adaptive response in the case of an emergency situation in flight.

Both the airline pilots and aviation students with high levels of cognitive flexibility showed a preference to use more task-oriented coping strategies. Johnson (2016) suggests that 'greater ability to generate and implement effective approaches is linked to greater use of pragmatic strategies to improve a situation' (p. ii). This statement can be interpreted a saying that an individual with high cognitive flexibility also has the ability to generate multiple solutions to reduce distress. Task-oriented coping strategies are predicted to be the most effective for dealing with stress (Higgins & Endler, 1995; Kraaij et al., 2002), and the use of this coping method demonstrates a higher level of resilience (Anthony, 1987; Boerner & Jopp, 2010; Kumpfer, 2002). Airline pilots with high cognitive flexibility might be assumed to expend more effort in improving the outcomes of stressful situations or adverse events by extensively employing more task-oriented coping strategies so that they can avoid the negative consequences of stress. Aviation students who engage in more task-oriented coping efforts when attempting to control hardship or obstacles encountered while completing a university degree or flight training are also predicted to engage to a large extent with this type of coping method to manage the demanding situation of the flying environment. Boerner and Jopp (2010) advise that individuals can use active problem-solving efforts that aim to improve or bring an end to an adverse situation while controlling their internal adjustments to remain resilient.

The findings from the group of airline pilots do not support the theory that the level of cognitive flexibility and preference for task-oriented coping strategies is associated with the level of stress. This might be because of the nature of the occupation: an airline pilot is considered to have one of the most stressful jobs in the world (Career Cast, 2013; Cranwell-Ward & Abbey, 2005). This is especially true for those in the role of captain, who have more responsibility and authority (Ragnarsdóttir, 2018) and are thus continuously exposed to a high level of stress during routine day-to-day tasks. Nevertheless, airline pilots' cognitive flexibility levels appeared higher than those of aviation students in this study. This implies that even though a high level of cognitive flexibility does not appear to influence stress levels, it can still prevent negative outcomes that may arise from stress. This inference is supported by the pilots in this study who exhibited either low or high levels of stress but still managed to safely operate their flights. It appeared that cognitive flexibility moderated the effects of stress. Thus, highly cognitively flexible airline pilots are assumed to obtain the resilience capability to withstand highly stressful demands such as those experienced in the flying context.

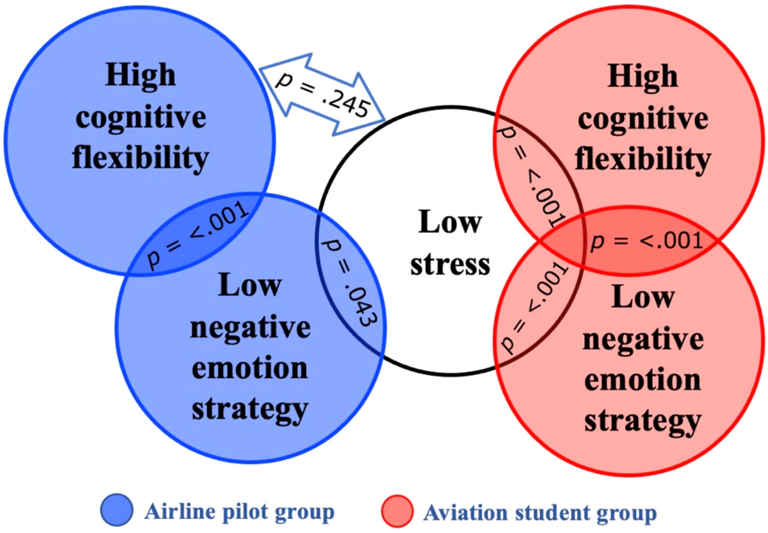
6.2 Stress Versus Cognitive Flexibility Versus Emotion-oriented Coping Strategies

The findings from the two studies on relationships between stress levels, cognitive flexibility levels and preference for emotion-oriented coping strategies highlight that a higher level of cognitive flexibility was associated with lower preference for emotion-oriented coping strategies in both airline pilots and aviation students. In addition, lower preference for emotion-oriented coping strategies was associated with lower stress levels for participants in both groups (see Figure 6.3).

Nevertheless, a higher level of cognitive flexibility was only directly associated with lower stress levels in aviation students; not airline pilots.

Figure 6.3

Comparison Between the Airline Pilot and Aviation Student Groups in Identified Relationships Between Stress, Cognitive Flexibility and Emotion-oriented Coping Strategies



Highly cognitively flexible airline pilots and aviation students were found to engage less with negative emotion coping strategies. Many other studies report similar results, with cognitive flexibility playing a mediating role in use of adaptive versus maladaptive coping styles (Asici & Sari, 2021; Johnson, 2016; Yakhnick & Ben-Zur, 2008). Ochsner and Gross (2007) explain that high levels of cognitive flexibility are linked to the experience of positive emotions, and positive emotions improve one's cognitive flexibility. Genet and Siemer (2011) suggest that to improve these abilities in unison, cognitive flexibility can be enhanced through the promotion of effective ER, which also links to improved resilience traits. Troy and Mauss (2011) concur, arguing that the ability to regulate emotions is a critical factor determining resilience because when one uses cognitive reappraisal to reframe negative emotions in a more positive way, this can increase positive emotion and assist in coping more appropriately with stress events. However, as found by Krpan et al. (2007), when an individual experiences a decline in executive functions such as working memory and mental flexibility when exposed to a stressor, dramatic increases in the engagement of emotion-oriented coping can occur. It is clear that both airline pilots and aviation students experience a range of emotions when encountering stress events. However, these emotions must be those that strengthen their cognitive flexibility and assist in gaining proficiency to generate multiple solutions to the problems they encounter. Therefore, it is reasonable to assume that even in the face of an emergency situation, highly cognitively flexible airline pilots or students who engage in less negative emotion coping can generate an effective automatic response to reverse a stressful situation and produce a positive outcome.

The airline pilots and aviation students who adopted less emotion-oriented coping strategies appeared to exhibit lower level of stress. Several studies on stress and coping (Carver, 2011; Dubow & Rubinlicht, 2011; Higgins & Endler, 1995; Kraaij et al., 2002) report a similar result, that participants highly engaged in emotion-oriented coping strategies had higher levels of stress. As Gabrys et al. (2018) explains, it is the nature of humans is to first employ negative emotions when responding to uncontrollable situations, yet the use of this type of coping method causes higher psychological and physical distress (Higgins & Endler, 1995). This idea also aligns with a study by Nowack (1989), who identified that professionals who reported the most intrusive negative thoughts also reported the most psychological distress when dealing with stress. Thus, airline pilots and aviation students could maintain their resilience capability by engaging less in negative emotion-oriented coping strategies such as self-blame, dwelling on their problems or blaming others, despite these strategies lowering their level of stress.

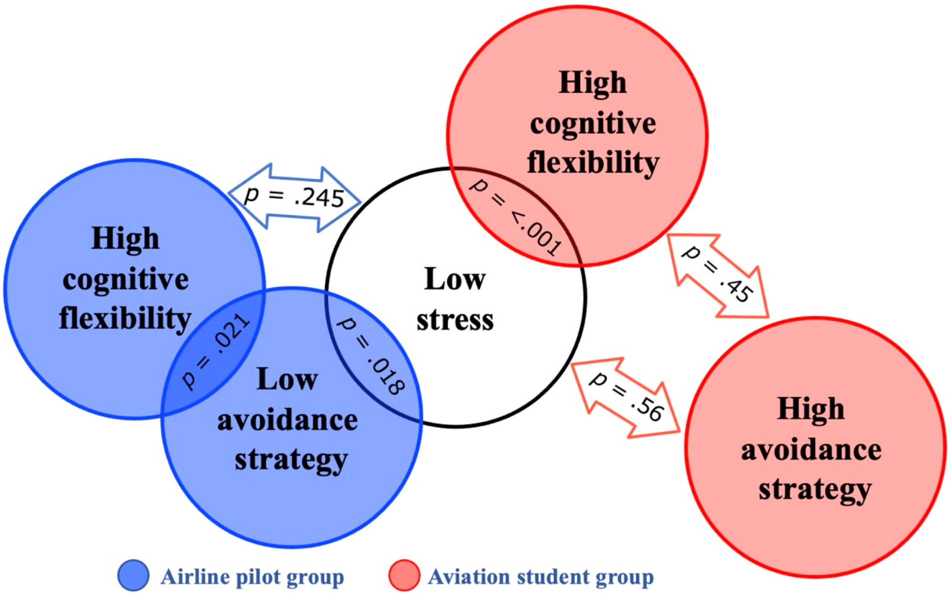
One way to engage less in negative emotion coping is through effective ER, which exerts effective control over one’s negative emotions. Genet and Siemer (2011) suggest that promoting effective ER will also increase cognitive flexibility, which is linked to improvements in resilience traits. It can be assumed that negative emotion-oriented coping is not an element of resilient pilots, and pilots are expected to avoid engaging in this type of coping method when dealing with stressful situations including in the event of an in-flight emergency, to avoid adverse outcomes.

6.3 Stress Versus Cognitive Flexibility Versus Avoidance-oriented Coping Strategies

Differences were found between the airline pilots and aviation students in regard to correlations between their stress levels, cognitive flexibility levels and preferences for avoidance-oriented coping strategies (see Figure 6.4). In the group of airline pilots, there was no direct correlation between cognitive flexibility and stress but highly cognitively flexible pilots who engaged in less avoidance coping methods had lower stress levels. Conversely, in the group of aviation students, those who had high levels of cognitive flexibility clearly showed lower levels of stress, although those with a higher preference for avoidance-oriented coping methods did not seem to show lower levels of cognitive flexibility or higher levels of stress.

Figure 6.4

Comparison Between the Airline Pilot and Aviation Student Groups in Identified Relationships Between Stress, Cognitive Flexibility and Avoidance-oriented Coping Strategies



Avoidance-oriented coping strategies are considered to be maladaptive coping methods that do not give rise to resilience (Bartone et al., 2017; Blalock & Joiner, 2000; Rutter, 2007; Sagone & Caroli, 2014) and the findings of this study strongly support the notion that highly cognitively flexible professional airline pilots are less likely to use this type of coping method to reduce their stress. Use of avoidance-oriented coping strategies, as specified by researchers (Kitano & Lewis, 2005; Penley et al., 2002) encourages individuals to employ behaviours of distance, escape or denial to avoid dealing with stressful demands. Some studies have also found that avoidance coping can contribute to mental health issues by creating symptoms of anxiety and depression (Greenglass et al., 1999; Li & Miller, 2017). Professional airline pilots rarely engage in this type of coping method during emergency situations as there is limited time for decision making and responding, even under high pressure and distress. This enables them to maintain or regain safety in flight. Resilient pilots do not use avoidance coping strategies to solve immediate flight safety issues because endeavouring to avoid a problem relating to flight safety will likely result in catastrophe.

The findings from the group of aviation students indicate that high preference for avoidance coping strategies was not strongly correlated with cognitive flexibility or stress levels. Unlike the findings from the group of airline pilots when it was indicated that high cognitively flexibility airline pilots showed less preference of avoidance coping strategies that resulted in lower level of stress. This suggests that the aviation students utilised avoidance coping methods to a considerably greater degree than did the airline pilots. However, preference for this type of coping method was not significantly associated with stress or cognitive flexibility levels in the aviation student group. It is apparent that aviation students have a preference for engaging in avoidance coping methods to avoid dealing with stress, a phenomenon that can be explained by the 'approach–avoidance' theory. This theory suggests that avoidance coping methods may be beneficial in the short term where an individual has very limited emotional resources during the initial stages of encountering stress, but will not be effective for reducing stress, and may even cause higher stress, in the long term (Carver, 2011; Lazarus, 1983; Roth & Cohen, 1986). Furthermore, avoidance coping methods are likely to be adopted if engagement of active coping methods does not alter the outcome of a situation (Carver et al., 1989). As the stress measures used for the airline pilots (job stress) and aviation students (university degree stress and flight training stress) differed, some avoidance coping methods might be effective in reducing the measured stress for the students but not the airline pilots.

If these students were to experience an emergency in flight while engaging in avoidance coping strategies, it would certainly result in them exposing themselves and the entire flight to danger. It is absolutely clear that no form of avoidance coping—whether short or long term—will be beneficial in flying conditions as it will not assist in avoiding or removing the danger. The group of professional airline pilots also showed that they were less likely to employ this type of coping method. Roth and Cohen (1986) suggest that avoidance coping can interfere with appropriate action towards solving stressors. Thus, to become more resilient in controlling an aircraft, aviation students need to learn more effective coping styles, such as task-oriented coping and positive emotion coping strategies to maintain safety in flight to the same standard as airline pilots. The development or improvement of adaptive coping skills can dramatically improve pilots' non-technical skills, especially when they have to work in a highly stressful environment such as flying an aeroplane.

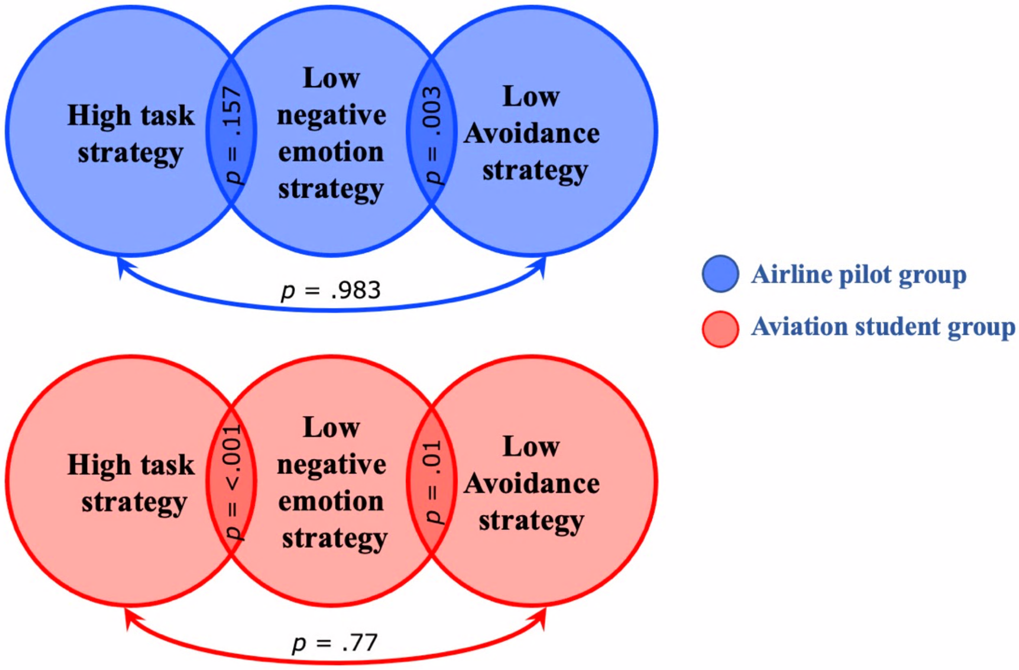
6.4 Relationship Between use of the Three Coping Strategies

The studies on the groups of airline pilots and aviation students identified that preference for emotion-oriented coping strategies determined the degree to which one adopted the other two coping strategies. Participants in both groups who showed less engagement with emotion-oriented coping strategies were highly engaged in task-oriented coping strategies and moderately engaged in avoidance-oriented coping strategies (see Figure 6.5). This suggests that negative emotions are likely to trigger avoidance coping but unlikely to influence or support the engagement of active coping strategies. The findings from this research support the theory that emotion-oriented coping can stimulate both adaptive and maladaptive coping, as positive emotion-oriented coping can lead to higher engagement with task-oriented coping strategies, whereas negative emotion-oriented coping can lead to higher engagement with avoidance-oriented coping strategies.

Lazarus (1991) explains that appraisal of a situation generates emotions—whether positive or negative—and this can result in people responding by fighting if they have positive emotions or fleeing if they have negative emotions. If a person appraises a stressor as controllable/changeable, then active coping strategies are likely to be engaged, whereas if they appraise a stressor as uncontrollable/unchangeable, then avoidance coping strategies are likely to be employed to escape from the stressful situation. In addition, Folkman (1984) points out that when encountering extreme stress, problem-focused coping will be accompanied by emotion-focused coping because it is important to have some control over one's emotions. Heightened emotions can interfere with the cognitive activities necessary for problem-focused coping. Thus, emotion-focused coping (via positive emotions) provides an opportunity for an individual to deal with stressors in a calm manner, with self-control, and make a positive reappraisal to prevent, minimise or reduce stress while encountering the distress (Carver, 2011; Kitano & Lewis, 2005; Lazarus et al., 1980).

Figure 6.5

Relationships Identified Between use of the Three Coping Strategies in the Two Studies



Both professional airline pilots and aviation students can encounter general stressors such as personal, health or financial issues that heighten their stress levels. As these kinds of stressors may take time to rectify, the combined practice of emotion, task and avoidance coping strategies may be acceptable and adequate to minimise or reduce stress until the individual can gain equilibrium or reach the resilience stage.

However, in encounters with emergency situations when pilots have to operate an aircraft and there is limited time to regain control over stressors, negative emotion coping and avoidance coping are not acceptable coping choices to prevent adverse outcomes. This is when cognitive flexibility comes into play in selecting a suitable coping method for a given situation. This notion aligns with those of Martin and Rubin (1995) and Martin and Anderson (1998), who highlight that cognitively flexible people exhibit stronger acknowledgment of possible behavioural adjustments based on situational factors than do those who can see only one proper or correct behavioural response. Although the findings of this research do not imply that cognitive flexibility is the only factor to lower pilots' stress levels, it does play a role in provoking the use of coping methods that are suitable for given stressful events. It is reasonable to assume that pilots who have high levels of cognitive flexibility in selecting coping methods that meet contextual demands, and who try to engage in more adaptive coping strategies to eliminate distress entirely, will have the resilience capability to overcome challenges they may experience in flight.

6.5 Effect of Workload on Stress and Resilience Factors

To compare how workload or responsibility might have affected the airline pilots' and student pilots' stress, along with the two resilience factors, the pilots were assessed on the basis of their annual flying hours and rank (captain vs co-pilot), and the student pilots according to whether they had attempted to gain their flying licence and a university degree at around the same time. Comparison of the findings across these two groups shows no difference in their cognitive flexibility levels or preference for emotion- or avoidance-oriented coping (see Table 6.2). However, student pilots who had tried to complete a degree and airline pilots in a captain position had higher stress levels than other group members. Additionally, it was identified that the co-pilot group adopted more task-oriented coping than the captain group.

Table 6.2

The Effect of Higher Workload on Different Groups

Group	Stress	CFI	Task	Emotion	Avoidance
Airline pilot group					
Different annual accumulated flying hours	p = .58	p = .36	p = .61	p = .76	p = .55
Captain *v*. co-pilot	Captain higher p = .02	p = .22	Co-pilot higher p = .045	p = .80	p = .80
EFS group					
Degree *v*. non-degree	Degree higher p = .03	p = .50	p = .70	p = .25	p = .23

The findings in this study imply that the greater sense of responsibility associated with the captain role induced higher stress levels in this group than in the group of co-pilots. In several research studies (Driskell & Salas, 1991; Helmreich, 1979; Klein, 1976), under highly stressful conditions, lower-status group members increased their dependence on decision making and problem solving and placed more responsibility for task performance onto a leader. Driskell and Salas (1991) explain that this phenomenon is called ‘centralisation of authority’, when all authority and decision-making activities shift to higher levels of a hierarchical structure during a crisis, and lower-range subordinates are willing to defer to leaders during a highly stressful event. An example of this can be seen in the study of Foushee and Helmrich (1988), where subordinate aircrew members were observed to become even more hesitant to take action during emergencies in simulation training. Therefore, it is reasonable to infer in the current study that a greater sense of responsibility and being relied on more for decision making induced higher stress in the captains during most flying tasks. Importantly, captains’ stress levels would be even higher if they had to encounter an emergency situation in which decision making and problem solving were highly critical.

The results of this research also suggest that the increased workload from flying more hours did not influence the airline pilots' level of stress, whereas many studies of health professionals have identified that higher workload is the primary cause of increased stress for those people (Birhanu et al., 2018; McCann et al., 2013; McVicar, 2003; Stordeur et al., 2001). One of the reasons that the professional airline pilots in this study were not overly stressed from a high workload may be the rules and regulations developed to limit pilots' maximum annual flying hours. A CASA (2019) instrument that took effect from 2 September 2019 specifies in *Civil Aviation Order 48.1 Instrument 2019* under *Civil Aviation Regulation 1988* that 'the cumulative flight time accrued by an FCM[13] during any consecutive 365-day period must not exceed 1 000 hours' (p. 38). This instrument was implemented during the period of data collection for this study (February–November 2020), before a new instrument came into effect from 2021 (CASA, 2021). These rules and regulations (combined with other required fatigue management mechanisms) are considered to assist in preventing pilots from working excessively, which might compromise their performance and introduce limitations in their operation of an aircraft. With the protection of this rule, pilots are unlikely to be overstrained with high flying workloads, which might help them reserve their energy when they encounter a real threat to flight safety, such as an emergency situation.

The group of student pilots in this study also had higher stress when they had to complete their university degree while studying for a flying licence. Johnson et al. (2008) found that graduate students in their study had difficulties balancing their role and personal versus academic responsibilities, which raised their level of stress. The study authors explain that the greater responsibility and workload associated with attempting to simultaneously complete two major goals may have heightened the perception of stress in the graduate students. This can help to explain that student pilots who try to achieve university degree at the same time as gaining flying licenses perceive higher stress due to the increase workload and responsibility from attempting to achieve major things at the same time.

[13] FCM = Flight crew member.

Surprisingly, increased responsibility and workload did not appear to be influence the airline pilots' or student pilots' cognitive flexibility: being a captain or co-pilot; flying more or fewer hours; and completing a university degree around the same time as gaining a flying licence or not, did not influence participants' cognitive ability levels. Many studies identify that a high workload has a strong effect on human cognitive performance; for example, it stimulates higher emotional stress and burnout, and a decline in critical decision-making processes (Cinaz et al., 2013; Hannula et al., 2008; Lin et al., 2011), which may induce human error (Yang et al., 2012). Some studies suggest that high workload does not significantly affect an individual's level of resilience (Kiziela et al., 2019; Pragholapati et al., 2020). Furthermore, a study on a group of Korean Air Force pilots conducted by Sung et al. (2019) found that cognitive flexibility moderated the relationship between these pilots' work stress and psychological symptoms. Therefore, the findings of this research suggest that a higher workload may affect some cognitive functions but not the ability to mentally shift between rules, strategies or tasks when facing new and unexpected conditions in the environment, especially given that a pilots' ultimate goal is to have the responsibility of maintaining safety in flight.

The findings from the two studies reported in this thesis indicate that participants in both groups were consistent in their coping behaviours regardless of the increased stress levels from higher responsibility and workload. However, the group of co-pilots was found to engage in more task-oriented coping strategies than the group of captains. Many research studies in the health professions have found that problem-focused coping strategies are the most effective coping methods to reduce the high level of stress that results from a high workload and can moderate the effects of stress, while emotion-focused coping and escape-avoidance behaviours are found to be ineffective coping methods (Acker, 2010; Chang et al., 2007; Maldonado, 2005). Kowalczyk et al. (2015) conducted a study on a group of 123 pilots and 113 anti-terrorist officers in military who took part in overseas air force missions and found that rational approaches such as use of task-orientated strategies or positive re-interpretation were more likely to be used by individuals with resilience personality traits when trying to solve difficult and stressful situations. A similar result was reported by Maciejczyk and Liszka (2013) for a group of police officers, when it was identified that task-oriented coping strategies were most engaged by officers working in traffic and crime-prevention departments. It could be inferred from this that higher workload and responsibility do not change resilient individuals' cognitive flexibility levels or preference for adaptive coping methods when they encounter difficult situations or adverse events.

6.6 Effect of Flying Experience on Stress and Resilience Factors

The findings from the two studies indicate that the level of flying experience was associated with stress levels, cognitive flexibility levels and the degree to which the participant adopted each of the three coping strategies. These factors were compared between the groups of NFS, EFS and professional airline pilots (see Table 6.3), which helped to identify at what stage development of resilience capabilities relating to pilots' non-technical skills might emerge.

The results from comparison of the groups of EFS and NFS indicate that the EFS group had lower stress levels and preference for emotion-oriented coping strategies, but higher cognitive flexibility levels and preference for task-oriented coping strategies than the NFS group. However, both groups adopted avoidance-oriented coping strategies to an equivalent degree. From this perspective, the EFS group clearly performed better than the NFS group in all aspects under study except the use of avoidance coping strategies.

Analysis within the EFS group based on flying experience in the form of total flight hours showed that total hours of flying experience did not alter the level of stress, cognitive flexibility, or preference for emotion-oriented coping strategies. However, it was identified that student pilots with more flying hours adopted more task- and avoidance-oriented coping strategies than those with fewer flying hours. Furthermore, the post-CPL student pilots (i.e., those with more flying experience) had higher stress levels and greater preference avoidance coping strategies than did the pre-CPL students. However, their cognitive flexibility levels and preference for task- and emotion-oriented coping strategies did not differ.

In addition, analysis of the group of airline pilots according to their flying experience as measured in two ways (number of years of flying experience and total flying hours) found no significant differences in stress levels or cognitive flexibility levels or preferences for the three coping strategies. Based on the findings for these three groups, it seems reasonable to infer that a higher level of flying experience—which the EFS group gained from flight training and the professional airline pilots gained throughout their flying careers—strengthens the two resilience capabilities to cope well with general stressors that may be encountered throughout these individuals' lives and more specific stressful situations such as an in-flight emergency.

Table 6.3

The Effect of Flying Experience on Different Groups

Group	Stress	CFI	Task	Emotion	Avoidance
EFS *v.* NFS	EFS lower; $p = .017$	EFS higher; $p = .002$	EFS higher; $p = <.001$	EFS lower; $p = .003$	$p = .80$
Within EFS					
Total flying hours	$p = .21$	$p = .34$	More flying hours more task; $p = .15$	$p = .86$	More flying hours more avoidance; $p = .14$
Pre-CPL *v.* post-CPL	Post-CPL higher $p = .19$	$p = .24$	$p = .54$	$p = .66$	Post-CPL higher; $p = .17$
Airline pilots					
Different total flying hours	$p = .28$	$p = .09$	$p = .37$	$p = .35$	$p = .35$
Different numbers of years of flying experience	$p = .67$	$p = .12$	2 groups differ; $p = .03$	$p = .48$	$p = .14$

The outcomes of this research show that pilots' cognitive flexibility and adaptive coping skills begin to develop when the individual commences flight training and is further strengthened throughout the training process. Flight training appears to make the most important contribution to formulating these two resilience abilities, in support of the 'stress inoculation' theory. Stress inoculation, or steeling effects, involve the process of improving resilience resources whereby an individual develops adaptive responses and higher-than-average resilience to cope with mild or manageable stress, which leads to a decreased negative response to subsequent uncontrollable stressors (Feder et al., 2010; Rutter, 2012; Southwick & Charney, 2012). When students are undergoing flight training, they unavoidably experience more types of stressors both from within and outside the training process that force them to expand their coping repertoires, bolstering their confidence in being able to apply various coping skills in a flexible fashion to overcome any hardships they may encounter. This is when cognitive flexibility must be enhanced to generate suitable coping strategies to overcome stressors. In this regard, the EFS group appeared to demonstrate greater cognitive flexibility, which provoked a preference for adaptive coping methods. This may explain why they appeared to cope better with stress than did the NFS group. Stressful experiences relating to flight training may form immunity against later stressors when these students encounter emergency situations at some stage in their flying career.

In addition, these two resilience abilities appear to be sustained, persistent and strengthened through higher levels of flying experience that enhance pilots' non-technical skills and mean that professional airline pilots appear to have higher levels of cognitive flexibility and more consistent engagement with adaptive coping methods to handle more severe types of stressors. relative to the EFS group. Stressors in the aviation environment, such as time pressure, high workload, fatigue, and many other strains may also be factors that support general stress inoculation in relating to flying. More importantly, pilot proficiency checks are also considered to be a form of stress inoculation in regard to situations relating to emergency events in flight as pilots are required to undergo this training process on a regular basis. David et al. (2009) states that 'stressful experiences that are challenging but not overwhelming appear to promote the development of arousal regulation and resilience' (p. 1). This emphasises that ongoing training with stressful situations prepares pilots to be ready to confront risky conditions and improves their effectiveness in responding to unexpected events whenever they are faced with a real threat during flight.

6.7 Effect of Age and Gender on Stress and Resilience Factors

Analysis of the level of stress, cognitive flexibility and preference for task, emotion and avoidance coping strategies in relation to age revealed no differences in these factors among the participating airline pilots. For the group of aviation students, the analysis revealed no age or gender differences in the factors under study. However, it was identified that increasing age was strongly associated with use of more task-oriented coping strategies. These results are summarised in Table 6.4.

Table 6.4

The Effect of Age and Gender Differences in the Two Groups

Group	Stress	CFI	Task	Emotion	Avoidance
Airline pilot group					
Age	$p = .60$	$p = .23$	$p = .96$	$p = .63$	$p = .27$
Gender*	–	–	–	–	–
Aviation student group					
Age	$p = .67$	$p = .28$	Older higher; $p = .017$	$p = .60$	$p = .16$
Gender	Weak difference: female higher; $p = .10$	$p = .56$	$p = .64$	$p = .38$	$p = .77$

*Tests in this category were not possible because there were only five participating female airline pilots.

6.7.1 Gender and Age Differences in Perceived Stress

When discussing perceived stress according to age or gender, researchers generally base their assessment on one of four types of stressors—trauma, life events, daily stressors, and chronic stress—to compare groups within their studies (Aldwin & Yancura, 2011; Davis et al., 1999). Such analysis often has inconsistent results. For example, Stawski et al. (2008) found that daily stressors decreased with age; both Chiriboga (1997) and Rabkin and Struening (1976) found that younger adults reported experiencing more life event stressors than older adults; and Aldwin et al. (2002) present data showing that middle-aged adults reported more chronic stressors than other age groups. However, the current research did not measure different types of stressors because it assumed that the participants were selected from a controlled environment with similar background setting. For instance, both airline pilots and aviation students are presumed to deal with stressors from flying, while aviation students also deal with stressors from their academic workload and flight training. In a study like the present one, where participants have similar background stressors, Folkman et al. (1987) suggest that in the contextual interpretation of stress from people in different age groups, there should be no age differences in the way people cope with similar sources of stress. Accordingly, this study showed that when a targeted population sample includes groups of airline pilots and aviation students, age is not one of the demographic factors that influences how such participants perceive stressors.

Research on how different genders perceive similar types of stressors also reports variable outcomes, which largely depend on the type of stressor under study (Davis et al., 2011). For example, with regard to daily stress, men perceive higher stress from work and financial events (Almeida et al., 2002) while women perceive higher stress from environmental and social issues (Folkman et al., 1987). However, with regard to major life events and chronic stress, females report greater exposure to this type of stressor (Davis et al., 1999). In the current research study, no significant differences were found between the male and female aviation students in how they perceived stress in relation to academic workload and flight training. Davis et al. (2011) emphasise that gender differences in stress tend to disappear when the genders are well-matched in employment status and occupational prestige. This implies that male and female airline pilots may perceive stress similarly when their workloads and responsibilities are at the same level, as demonstrated by the results for the group of aviation students.

6.7.2 Gender and Age Differences in Cognitive Flexibility

The cognitive flexibility literature presents consistent results on age differences but inconsistent results on gender differences. Age and cognitive flexibility studies generally agree that cognitive flexibility declines with increasing age, starting as early as 45 years of age (Head et al., 2009; Mell et al., 2005; Peltz et al., 2011; Rhodes & Kelley, 2005; Singh-Manoux et al., 2012; Wecker et al., 2005; Wilson et al., 2018). In contrast, research on gender differences in cognitive flexibility offers mixed results: one study identified that female pre-service teachers were more cognitively flexible than male pre-service teachers (Hanife, 2018), while another determined that male university students had higher cognitive flexibility than female students (Roothman et al., 2003). The current study found no differences in cognitive flexibility levels among either the airline pilots or aviation students with a diverse age range (18–60 years old). Furthermore, the findings for the group of aviation students agree with those of many other studies involving university students (Bertiz & Karoglu, 2020; Kercood et al., 2017; Kim & Omizo, 2006) that there is no difference between genders in their level of cognitive flexibility.

The results from this field of research suggest that cognitive flexibility is more likely a stable trait of an individual rather than an ability that increases or decreases with age or that could be differentiated by gender. As the current study also found that age or gender of airline pilots and aviation students has no influence on their perceived stress, it is reasonable to infer that an individual's level of cognitive flexibility has more of an effect on how one perceives stress than does their age or gender. Therefore, age and gender variables did not appear to be factors influencing cognitive flexibility levels in this study, nor did they indicate the level of resilience capability.

6.7.3 Gender and Age Differences in Preference for Different Coping Strategies

The literature on the association between age and gender and the preferred type of coping strategy also presents mixed results. Some researchers suggest that older adults use less avoidance or escapism coping but a higher or similar level of problem-focused coping as young adults (Aldwin & Revenson, 1985; Blanchard-Fields et al., 1991; Irion & Blanchard-Fields, 1987), while in other research younger adults engaged in more problem- (Folkman et al., 1987) or emotion-focused coping (Brudek et al., 2019; Kruczek et al., 2020). Regarding gender differences in coping, the literature also indicates mixed findings: some studies have found that men use more problem-focused and avoidance coping than women (Berzonsky, 1992; Folkman & Lazarus, 1980; Higgins & Endler, 1995) while others show women use more emotion-focused and avoidance coping than men (Billings & Moos, 1981; Brougham et al., 2009; Pearlin and Schooler, 1978). Despite these findings—albeit mixed—of an effect of age and gender, the current study on the group of aviation students did not identify any differences in coping strategy preferences between genders. Task-oriented coping appeared to be the only strategy that was more preferred with increasing age among the students; however, this preference did not differ between age groups of airline pilots.

In regard to the coping strategy preferences of diverse groups based on age or gender, Davis et al. (2011), Folkman et al. (1987) and McCrae (1982) advise that the choice of coping strategy by young and old, and by male and female participants largely depends on the type of stressor and whether they think the situation is controllable/ changeable or uncontrollable/unchangeable. This study supports this notion and highlights that those male and female aviation students did not differ in their coping preferences in response to similar types of stressors. Although the number of female airline pilots was too small to enable comparison between males and females, it is reasonable to assume that the results from Study 2 on the university students translate to the professional pilot group with respect to gender. Although there was no difference in between younger and older students, or younger and older airline pilots in their preference for emotion or avoidance coping strategies, use of more active coping strategies appeared to increase with age. Aldwin (1991) points out that use of coping strategies is an intrinsic development process and people are likely to be exposed to a variety of problems as they age. These experiences will support their learning in regard to what types of coping strategy are unproductive and which might help them achieve their goals. Therefore, there should be a focus on coping efficacy, to indicate whether an individual uses coping strategies that are effective for a particular situation.

The discussion throughout this section indicates that any differences in age and gender did not appear to greatly influence the study participants' levels of resilience, with the exception that the preference for more task-oriented coping strategies increased with age in the group of aviation students. Research results promote many different perspectives on these demographic variables: some suggest that resilience ability increases with age (Campbell-Sills et al., 2009; Leipold et al., 2019) while others indicate a negative correlation between resilience and age (Beutel et al., 2009; Gillespie et al., 2009; Lamond et al., 2008). Some researchers suggest that males are more resilient than females (Rahimi et al., 2014) while others argue the opposite (Isaacs, 2014; Vinayak & Judge, 2018). The current findings for professional airline pilots and aviation students support the idea that resilience is a stable trait of the individual —for example, one who can attain a CPL and acquire a job as a professional airline pilot—rather than an ability that can be influenced by age or gender. Regardless of their age and gender, all professional pilots have to undergo the same training process, which shapes their safety attitudes and mindsets to be more resilient in maintaining safe flight.

6.8 Chapter Summary

The findings from this thesis show that individuals with high levels of cognitive flexibility engage in more adaptive coping styles when comparing to those students with lower cognitive flexibility levels—that is, task-oriented coping strategies—and engage in less maladaptive coping styles, which are negative emotion-oriented coping strategies. The findings from the group of professional airline pilots suggest that pilots who exhibit high levels of cognitive flexibility and preferences for adaptive coping styles do not always experience lower levels of stress when working in a high-risk environment such as flying an aeroplane. Airline pilots might experience lower levels of stress only when they engage to a lesser degree in maladaptive coping styles such as negative emotion coping and avoidance coping strategies. Conversely, the results for the group of aviation students show that the degree to which they adopted avoidance coping strategies did not affect their level of stress.

Higher workload and increased responsibility also appeared to have an effect on the level of stress among the study participants, but a higher level of flying experience appeared to improve cognitive flexibility and regulate participants to a more adaptive coping style. The demographic variables of age and gender did not affect stress levels, cognitive flexibility levels or the degree to which participants adopted emotion- and avoidance-oriented coping strategies across any groups in this research study. Nevertheless, Study 2 identified that engagement with task-oriented coping strategies appeared to increase with age. The findings from this research illuminate that the development or enhancement of these capabilities can greatly improve one's resilience. This suggests that providing resilience training to pilots may enhance their non-technical skills and in turn maximise flight safety when they have to work in a highly stressful environment such as flying an aeroplane.

CHAPTER 7: CONCLUSION

'Resilience' is the ability to withstand, bounce back or even thrive from stressful situations or adverse events. It is a concept that has long been studied in the human development field of research (e.g., psychology, psychobiology, psychopathology). However, very limited research on the topic of resilience has been conducted in the field of aviation human factors. Numerous researchers in the specified fields have attempted to identify a resilient individual by examining risk factors, supportive factors and how to promote resilience in the focal group of their studies. However, to this researcher's knowledge, no study specifies a complete guide on how an individual can be trained to become resilient, because risks and supportive or protective factors are influenced by many variables including occupation, level of expertise, age, gender, and environmental background. Regarding ICAO's requirement for pilots to operate an aircraft safely, effectively, and efficiently to comply with Annex 6 (ICAO, 2010), this thesis has endeavoured to identify elements of resilient pilots. It is theorised that these resilience factors can complement pilots' non-technical skills and promote their resilience capability when working in the high-risk environment of flying an aeroplane. It is expected that these findings will contribute to knowledge in the aviation field and lead to the development of intervention programs to promote the identified factors among pilots from the ab initio to the professional level.

The investigation of how 'cognitive flexibility' and 'active coping strategies' influence pilots' stress levels when working in high-risk environments indicates that these two resilience factors are likely to be protective components supporting pilots' resilience capabilities, although they do not directly play a mediating role in mitigating the high levels of stress in pilots. The results of tests of various hypotheses among the groups of professional airline pilots indicate that professional pilots display greater levels of cognitive flexibility and preference for adaptive coping strategies when they encounter any type of stressor. Additionally, highly cognitively flexible pilots are unlikely to engage in maladaptive coping methods, which include negative emotion coping and avoidance coping, when they face stressful situations. Moreover, a number of variables including level of flying experience, age, gender, and workload do not influence the two resilience capabilities, as pilots across groups show similar levels of both abilities. It can be assumed that with greater levels of these resilience traits, professional airline pilots will be more resilient during an emergency.

In Study 2 on the group of aviation students, cognitive flexibility and active coping strategies also emerged as protective factors that moderated the students' stress levels, whereas their engagement with negative emotion coping heightened their level of stress. It is also evident that flight training was a major factor enhancing an aviation student's resilience capability as students in the EFS group displayed significantly higher cognitive flexibility levels and preferences for task-oriented coping efforts than those in the NFS group when encountering stress. A higher level of cognitive flexibility and engagement with task-oriented coping strategies determines the speed with which student pilots can progress through their flight training. Older students also demonstrated higher engagement in task-oriented coping efforts. From these findings, it can be assumed that flight training is an activity that inoculates pilots against different types of stressors, as the student pilots needed to broaden their cognitive abilities and expand their behavioural repertoires and coping strategies, to overcome hardships and be able to gain their CPL, which in turn enhanced their resilience.

In conclusion, resilient pilots are those who have greater cognitive flexibility who engage more in adaptive coping strategies when working in a high-risk environment such as flying an aeroplane. These abilities are developed through initial flight training as well as being nurtured through the ongoing training process as part of pilot proficiency checks to ensure that pilots retain the set of competencies required to operate an aircraft safely, effectively, and efficiently. This study clarifies that highly cognitively flexible pilots prefer to engage with adaptive coping methods as part of their decision making when facing stressful events. Therefore, to become a resilient pilot, one must obtain a good level of cognitive flexibility while actively or strongly engaging with both task- and positive emotion-oriented coping strategies.

Based on these conclusions, it is recommended that universities, flying training providers, charter companies and airlines consider developing or enhancing resilience ability, (with a focus on cognitive flexibility and active coping strategy), for people who work in a high-risk environment. It is suggested that resilience knowledge is integrated into tertiary level studies, prior to students commencing flight training to allow students to develop their understanding that experiencing difficult times or stressful situations is the process of developing or improving resilience traits. Thus, they should feel motivated to be resilient when exposed to any serious threats or stressors on their path to achieving their future flying career. Then, during the flight training process, training providers should provide different training scenarios and expose students to unexpected events. This exposure will give an incentive and enduring effect on improving resilience ability when student pilots attempt to complete their flying licences. It is also recommended that even at the professional airline pilots' level, resilience training should be an ongoing practice or resilience capability should be regularly revised the same way as a biennial flight review. This can ensure that pilots are monitored for their resilience performance in a long term. With the significant findings from this thesis, it is recommended that resilience training should be seriously considered by national aviation regulators to be embedded in the pilot training syllabus as well as in the recurrency check.

Additionally, further research should include embedding a resilience training program within a university or education setting to observe whether this training program can be effective in improving resilience. Furthermore, this training concept should be implemented in other segments of aviation involving high-stress roles such as Air Traffic Controllers. With more findings on this research, the resilience intervention program may be well-established to support people in the aviation industry to work in a high-risk environment in a long term.

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APPENDICES

Appendix 1 Cognitive Flexibility Inventory (CFI)

20-Item Cognitive Flexibility Inventory *

Please choose the appropriate response for each item:

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
I am good at "sizing up" situations.							
I have a hard time making decisions when faced with difficult situations.							
I consider multiple options before making a decision.							
When I encounter difficult situations, I feel like I am losing control.							
I like to look at difficult situations from many different angles.							
I seek additional information not immediately available before attributing causes to behaviour.							
When encountering difficult situations, I become so stressed that I cannot think of a way to resolve the situation.							
I try to think about things from another person's point of view.							
I find it troublesome that there are so many different ways to deal with difficult situations.							
I am good at putting myself in others' shoes.							
When I encounter difficult situations, I just don't know what to do.							
It is important to look at difficult situation from many angles.							
When in difficult situations, I consider multiple options before deciding how to behave.							
I often look at a situation from different view points.							
I am capable of overcoming the difficulties in life that I face.							
I consider all the available facts and information when attributing causes to behaviour.							
I feel I have no power to change things in difficult situations.							
When encounter difficult situations, I stop and try to think of several ways to resolve it.							
I can think of more than one way to resolve a difficult situation I'm confronted with.							
I consider multiple options before responding to difficult situations.							

Appendix 2 Job Stress Survey (JSS) Licence Agreement with PAR

Creating Connections. Changing Lives. PAR®

Addendum No. 3 to the JSS License Agreement
with
Maneerat Tianchai
at the University of Southern Queensland

This Addendum to the License Agreement dated August 23, 2019, by and between Psychological Assessment Resources, Inc. (PAR), and Maneerat Tianchai (Licensee), is to be deemed a part of the Agreement and should be attached as a rider to that Agreement.

1) Licensee and PAR agree to extend the above listed License Agreement until January 30, 2021. Any further extension of the Agreement will be upon mutual agreement of both parties.

All other terms and conditions of the original License Agreement dated August 23, 2019 will apply to this Addendum.

IN WITNESS WHEREOF, the parties hereto have executed and delivered this Addendum to the original License Agreement dated August 23, 2019 as of the 27th day of August, 2020. **Text**

ACCEPTED AND AGREED:

University of Southern Queensland:

BY: Maneerat

MANEERAT TIANCHAI

Title: **Ms**

DATE: **27/08/2020**

PAR CUSTOMER No.: 113537

ACCEPTED AND AGREED:

PAR:

BY: Vicki M McFadden

VICKI M. MCFADDEN

Title: PERMISSIONS SPECIALIST

DATE: August 27, 2020

JSS Tianchai Bates Lee (Lic Agr 08-23-2019) Univ of Southern QLD Extension Addendum No 3 - 8-26-2020
16204 N. Florida Ave. | Lutz, FL 33549 | 813.968.3003 | parinc.com

Appendix 3 Coping Inventory for Stressful Situation (CISS)

Permission to Copy with MHS

MHS
Multi-Health Systems Inc.

P.O. Box 950
North Tonawanda, NY 14120-0950
Tel: 1-800-456-3003
Fax: 1-888-540-4484
Head Office:
3770 Victoria Park Ave.
Toronto, ON, Canada M2H 3M6
Tel: (416) 492-2627, 1-800-268-6011
Fax: (416) 492-3343, 1-888-540-4484
Email: customerservice@mhs.com

QUOTE	
Quote No	QUO-04085-V6T7Y3
Date	2019-11-26
Customer ID	A0000031438
Order No	
Shipper ID	
Order Type	
Terms	

INVOICE ADDRESS	DELIVERY ADDRESS
Maneerat Tianchai University of Southern Queensland 37 Sinnathamby Bvd Springfield Central, QLD 4300 AU	Maneerat Tianchai 37 Sinnathamby Bvd Springfield Central, QLD 4300 AU

Notes:

Page **1** of **2**

ORDER DATE	DELIVERY METHOD	CUSTOMER P.O. NUMBER		
2019-11-26	INT SEE CS			
ITEM NUMBER	**DESCRIPTION**	**QTY**	**PRICE**	**NET PRICE**
PER413	Permission to Copy CISS - Adult -English	200	USD4.00	USD800.00
CI3POD	CISS Manual (Adult/Adolescent)	1	USD63.00	USD63.00

Continue on other side....

Detach this stub and enclose with your remittance. Keep the above portion for your records

MHS
Multi-Health Systems Inc.

US Banking Info:
Beneficiary Bank: M&T Bank
Bank Address: One M&T Plaza, Buffalo, NY, 14203-2399
Account Name: Multi-Health Systems Inc.
Bank Account: 150185
ABA: 022000046
Swift Code: MANTUS33
Remittance Advice: AR@MHS.COM

QUOTE	
Quote No	QUO-04085-V6T7Y3
Date	2019-11-26
Customer ID	A0000031438
Order No	
Shipper ID	
Order Type	
Terms	

Remit To:
P.O. Box 950
North Tonawanda, NY
14120-0950
Tel: 1-800-456-3003

Payment From:
Maneerat Tianchai
University of Southern Queensland
37 Sinnathamby Bvd
Springfield Central, QLD 4300
AU

AMOUNT DUE USD$

AMOUNT PAID USD$

Please note our EIN: 98-0369592

Page **2** of **2**

ORDER DATE	DELIVERY METHOD	CUSTOMER P.O. NUMBER		
2019-11-26	INT SEE CS			
ITEM NUMBER	**DESCRIPTION**	**QTY**	**PRICE**	**NET PRICE**
PER413	Permission to Copy CISS - Adult -English	200	USD4.00	USD800.00
CI3POD	CISS Manual (Adult/Adolescent)	1	USD63.00	USD63.00

This is your proof of purchase; please retain for your records

Sales Total	USD863.00
Shipping & Handling	USD43.00
Discount	USD258.90
Sales Tax	USD0.00
TOTAL USD$	USD647.10

Please note our EIN: 98-0369592

Appendix 4 Ethics Approval

USQ

Maneerat Tianchai <u1099512@umail.usq.edu.au>

[RIMS] USQ HRE Amendment - H19REA301 (v1) - Expedited review outcome - Approved

Human Ethics <Human.Ethics@usq.edu.au> Mon, Mar 9, 2020 at 2:56 PM
To: Maneerat Tianchai <Maneerat.Tianchai@usq.edu.au>
Cc: Paul Bates <Paul.Bates@usq.edu.au>

Dear Maneerat

The revisions outlined in your HRE Amendment have been deemed by the USQ Human Research Ethics Expedited Review process to meet the requirements of the National Statement on Ethical Conduct in Human Research (2007). Your project is now granted full ethical approval as follows.

USQ HREC ID: H19REA301 (v1)
Project title: An investigation of how "Cognitive Flexibility ability and Active-coping strategy" influence pilots' stress level when working in high-risk environment.
Approval date: 09/03/2020
Expiry date: 16/12/2022
Project status: Approved with conditions.

The standard conditions of this approval are:

(a) conduct the project strictly in accordance with the proposal submitted and ethics approval, including any amendments made to the proposal required by the USQ HREC, or affiliated University ethical review processes;

(b) advise the USQ HREC (via human.ethics@usq.edu.au) immediately of any complaint or other issue in relation to the conduct of this project which may warrant review of the ethical approval of the project;

(c) make submission for ethical review and approval of any amendments or revision to the approved project prior to implementing any changes;

(d) complete and submit a milestone (progress) report as requested, and at least for every year of approval; and

(e) complete and submit a milestone (final) report when the project does not commence within the first 12 months of approval, is abandoned at any stage, or is completed (whichever is sooner).

Additional conditions of this approval are:

(a) Please ensure you provide the Ethics Office with the email evidence of permission to recruit USQ students once it is received.

Failure to comply with the conditions of approval or the requirements of the National Statement on Ethical Conduct in Human Research (2007) may result in withdrawal of ethical approval for this project.

If you have any questions or concerns, please contact an Ethics Officer.

Kind regards

Human Research Ethics

University of Southern Queensland
Toowoomba – Queensland – 4350 – Australia
Phone: (07) 4631 2690
Email: human.ethics@usq.edu.au

Appendix 5 Perceived Stress Scale (PSS) Questionnaire

10-items Perceived Stress Scale

*

Please choose the appropriate response for each item:

	0 = Never	1 = Almost Never	2 = Sometimes	3 = Fairly Often	4 = Very Often
In the last month, how often have you been upset because of something that happened unexpectedly?	○	○	○	○	○
In the last month, how often have you felt that you were unable to control the important things in your life?	○	○	○	○	○
In the last month, how often have you felt nervous and "stressed"?	○	○	○	○	○
In the last month, how often have you felt confident about your ability to handle your personal problems?	○	○	○	○	○
In the last month, how often have you felt that things were going your way?	○	○	○	○	○
In the last month, how often have you found that your could not cope with all the things that you had to do?	○	○	○	○	○
In the last month, how often have you been able to control irritations in your life?	○	○	○	○	○
In the last month, how often have you felt that you were on top of things?	○	○	○	○	○
In the last month, how often have you been angered because of things that were outside of your control?	○	○	○	○	○
In the last month, how often have your felt difficulties were pilling up so high that you could not overcome them?	○	○	○	○	○

Appendix 6 Perceived Stress Scale (PSS) public permission of use

PERMISSION FOR USE OF THE PERCEIVED STRESS SCALE

I apologize for this automated reply. Thank you for your interest in our work.

PERMISSION FOR USE BY STUDENTS AND NONPROFIT ORGANIZATIONS: If you are a student, a teacher, or are otherwise using the Perceived Stress Scale (PSS) without making a profit on its use, you have my permission to use the PSS in your work. Note that this is the only approval letter you will get. I will not be sending a follow-up letter or email specifically authorizing you (by name) to use the scale.

PERMISSION "FOR PROFIT" USE: If you wish to use the PSS for a purpose other than teaching or not for profit research, or you plan on charging clients for use of the scale, you will need to see the next page: "Instructions for permission for profit related use of the Perceived Stress Scale".

QUESTIONS ABOUT THE SCALE: Information concerning the PSS can be found at https://www.cmu.edu/dietrich/psychology/stress-immunity-disease-lab/index.html (**click on scales on the front page)**. Questions about reliability, validity, norms, and other aspects of psychometric properties can be answered there. The website also contains information about administration and scoring procedures for the scales. Please do not ask for a manual. There is no manual. Read the articles on the website for the information that you need.

TRANSLATIONS: The website (see URL above) also includes copies of translations of the PSS into multiple languages. These translations were done *by other investigators*, not by our lab, and we take no responsibility for their psychometric properties. If you translate the scale and would like to have the translation posted on our website, please send us a copy of the scale with information regarding its validation, and references to relevant publications. If resources are available to us, we will do our best to post it so others may access it.

Good luck with your work.

Sheldon Cohen
Robert E. Doherty University Professor of Psychology
Department of Psychology
Baker Hall 335-D
Carnegie Mellon University
Pittsburgh, PA 15213