LOCUS OF CONTROL AS MODERATOR IN THE RELATIONSHIP BETWEEN INTERPERSONAL RELATION BEHAVIOUR AND RESILIENCE IN THE HIGH RELIABILITY ORGANISATION (HRO) ENVIRONMENT OF AVIATORS

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STUDENT DECLARATION

I, Izak Theo Kotzé, hereby assert that the dissertation I submit for the degree Master of Social Science with specialisation in Psychology at the University of the Free State is my personal, autonomous work and that this dissertation has not been submitted previously at/in another university or faculty. Furthermore, I cede copyright of this dissertation in favour of the University of the Free State.

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LIST OF ABBREVIATIONS

HRO	High Reliability Organisation
FIRO-B	Fundamental Interpersonal Relations Orientation–Behavioural Scale
ASLOC	Aviation Safety Locus of control Scale
I-BORA	Inventory to assess Behaviour towards Organisational Resilience in Aviation
LOC	Locus of Control
CRM	Crew Resource Management
ICAO	International Civil Aviation Authority
SOP	Standard Operating Procedure
SACAA	South African Civil Aviation Authority
SII	Social Interactive Index

ABSTRACT

The technological research and advancements of machines in the 21st century have accelerated the human endeavour into extreme and unusual environments. The establishment of these environments, such as the confined cockpit of an aircraft, has placed noted demands on the human capability to adapt to faster, more complex machines while saturated in an over stimulating environment (Antonovich, 2008; Driskell & Olmstead, 1989).

The vast amount of research in this field has led to the enhancement and development of safer, more efficient machines. Consequently aviation is a field where errors occur rarely but where the consequences of any error are extreme. The potential for failure is high, however, the amount of actual occurring failures are low (Baker et al., 2006). This phenomenon qualifies aviation as a High Reliability Organization (HRO) (Baker et al., 2006; Bourrier, 2011; Rochlin, 2011). In the HRO environment the crew serves as the central core of all processes, thus highlighting human essence (Reason, 2001; Wesnser, 2015). Yet shortcomings exist in understanding and improving the social interaction of individuals as part of the crew in the cockpit of the aircraft (John Paul et al., 2010).

Human beings are the source of resilience in the complex system of aviation and the reason that things go right (Dekker & Woods, 2010). The capacity to be resilient however is rooted within a bond of secure (close attachment) relationships yet cannot be attributed to one specific factor. These predictors are referred to as protective factors (Prince & Embury, 2013). Fundamental basic human needs, characterised by interactive relation behaviour (Sullivan, 1953) is deemed to be such an important protective factor. However, as much as the dynamic interplay of interpersonal needs are crucial for resilient behaviour when in distress, motivation to satisfy social needs can lead to behaviour that erodes resilience and interferes with preserving the living system.

The phenomenon of locus of control (LOC), conceptualised as the belief that a person's behaviour determines consequences either as an active agent, by being master of their own fate or by a function of chance (Thomas, 2017), may provide information on how to understand and improve the social interactive dynamic of the functioning of the cockpit crew and promote resilience (Woods, 2020). LOC may serve as the motivation for potential behaviour to attain interpersonal need satisfaction (Thomas, 2017).

Against this background the aim of this study was to investigate the dynamics of human interaction and human social needs in an HRO. More specifically, the objective was to identify whether there is a significant relationship between resilience and fundamental interpersonal orientation and secondly to determine if the behaviour that results from this orientation is moderated by a pilot's locus of control. A quantitative research approach, non-experimental type has been employed. A correlational design was utilised (Howell, 2017). The measuring instruments included a biographical questionnaire, Fundamental Interpersonal Relations Orientation–Behavioural Scale (FIRO-B), Aviation Safety Locus of Control Scale (ASLOC) and the Inventory to assess Behaviour towards Organisational Resilience in Aviation (I-BORA).

Results from this study indicated that only low I-LOC statistically significantly moderates the relationship between interpersonal relation orientation and resilience of aviators in a positive way. The results found that in aviators with a low I-LOC an increase in their overall interpersonal relation orientation will lead to a direct proportional increase in their resilience. Furthermore, the findings indicated that E-LOC does not have a moderating effect on the relationship between interpersonal relation orientation and resilience. The finding emphasises the need for further research on the influence of LOC regarding the relationship between interpersonal behaviour orientation and resilience in the HRO context.

OPSOMMING

Die tegnologiese vooruitgang van masjiene in die 21ste eeu het menslike strewes in die rigitng van ekstreme, onnatuurlike omgewings gestuur. Hierdie omgewings, soos die beperkte kajuit van 'n vliegtuig, het meer druk op die mens se vermoë geplaas om in omgewings, wat alreeds oorstimulerend is, aan te pas by masjiene wat vinniger en meer kompleks funksioneer (Antonovich, 2008; Driskell & Olmstead, 1989).

Groot hoeveelhede navorsing in hierdie veld het gelei tot die verryking en ontwikkeling van veiliger, meer effektiewe masjiene/vliegtuie. Gevolglik kom foute binne lugvaart selde voor, maar die gevolge van enige fout kan noodlottig wees.Die potensiaal vir mislukking is dus hoog, alhoewel die werklike mislukkings wat voorkom laag is (Baker et al., 2006). Hierdie verskynsel kwalifiseer lugvaart as 'n Hoë Betroubaarheid Organisasie (HBO) (Baker et al., 2006; Bourrier, 2011; Rochlin, 2011). Die bemanning/span in 'n vliegtuig dien as die kern van alle prosesse in die HBO en beklemtoon menslike essensie in hierdie omgewings

(Reason, 2001; Wesnser, 2015). Tog bestaan daar tekortkominge rakende die begrip en verbetering van die sosiale interaksie van individue as bemanning binne-in die kajuit van ‘n vliegtuig (John Paul et al., 2010).

Individue is die bron van veerkragtigheid in die komplekse sisteem van lugvaart en ook die rede vir suksesse (Dekker & Woods, 2010). Die kapasiteit om veerkragtig te wees is egter gegrond in hegte verhoudinge (gehegtheid), en kan derhalwe nie aan ‘n enkele faktor toegeskryf word nie. Enige voorspellers van veerkragtigheid staan bekend as beskermende faktore (Prince & Embury, 2013). Basiese menslike behoeftes, wat deur interaksie en verhoudinge gekenmerk word (Sullivan, 1953), word beskou as so ‘n belangrike beskermende faktor. Tog ten spyte daarvan dat die interaktiewe dinamika van interpersoonlike behoeftes krities is vir veerkragtigheid wanneer in gevaar, kan die dryf na bevrediging van interpersoonlike behoeftes ook lei tot gedrag wat veerkragtigheid verminder en die oorlewing van die lewende sisteem in gevaar stel.

Die fenomeen van lokus van beheer gekonsepsualiseer as die siening dat ‘n persoon sy/haar gedrag, en die gepaardgaande gevolge, kan sien as ‘n aktiewe gevolg deur in beheer te wees van sy/haar eie lot, óf as ‘n funksie van kans (Thomas, 2017), kan inligting verskaf oor hoe om die interaktiewe sosiale dinamika van die funksionering van die kajuitbemanning te begryp en bevorder (Woods, 2020). Lokus van beheer dien dan as die motivering vir potensiële gedrag om aan ‘n individu se interpersoonlike behoefte te voldoen (Thomas, 2017).

Teen hierdie agtergrond was die oogmerk van hierdie studie om die dinamika van menslike interaksie en behoeftes in die HBO te ondersoek. Die doel, meer spesifiek, was om eerstens te identifiseer of daar ‘n beduidende verhouding bestaan tussen veerkragtigheid en fundamentele interpersoonlike oriëntasie. Tweedens, om te bepaal of die gedrag, wat vanuit hierdie oriëntasie ontstaan, modereer word deur ‘n vlieënier se lokus van beheer. Hierdie is ‘n kwantitatiewe, nie-eksperimentele studie en daar is gebruik gemaak van ‘n korrelasionele navorsingsontwerp (Howell, 2017). ‘n Biografiese vraelys het deel gevorm van die meetinstrumente, saam met die Fundamentele Interpersoonlike Verhoudingsoriëntasie Gedragskaal (FIRO-B) Lugvaart Veiligheid Lokus van Beheer Skaal (ASLOC) en die Inventaris om Gedrag teenoor Organisatoriese Veerkragtigheid in Lugvaart te Assesseer (IBORA).

Die resultate van die studie het aangedui dat slegs lae interne lokus van beheer die verhouding tussen interpersoonlike verhoudingsoriëntasie en veerkragtigheid in vlieëniers statisties beduidend, positief modereer. Verder is bevind dat vlieëniers met ‘n lae interne lokus van beheer se veerkragtigheid en interpersoonlike verhoudingsoriëntasie direk eweredig toeneem. Eksterne lokus van beheer het geen modererende effek op die verhouding tussen interpersoonlike verhoudingsoriëntasie en veerkragtigheid getoon nie. Hierdie bevinding beklemtoon die behoefte aan verdere navorsing betreffende die effek wat lokus van beheer op die verhouding tussen interpersoonlike verhoudingsoriëntasie en veerkragtigheid in die HBO-konteks het.

CHAPTER ONE

INTRODUCTION AND ORIENTATION TO THE STUDY

1.1 Introduction

The purpose of this study is to establish the role that locus of control plays in the relationship between the interpersonal relation behaviour and resilience of aviators in the HRO environment. Literature is abundant on the individual and combined psychological constructs and factors namely locus of control, interpersonal relation behaviour and resilience respectively that are included within this study. Furthermore aviation literature is also sufficient with regards to High Reliability Organizations (HRO`s) and the influence of human factors within the field. However, little research was found, during my literature review, which brings together the interactive effect of the aforementioned psychological variables on the HRO as well as the aviator within the HRO. Therefore, this study further aims to fill a gap within the current literature (as on 2 December 2021).

In doing so, the researcher aims to contribute to the understanding of human behaviour and the possible prediction of human behaviour within the context of aviation, with the intent to focus more on the effect of LOC, resilience and interpersonal relation behaviour on accidents and safety within the aviation HRO. Understanding this small, unexplained variance might significantly improve the safety orientation of the industry. It might merely increase the self-awareness of an individual which can reduce the risk of being involved in an accident. By only changing a single factor in a system of multiple redundancies and levels of defence one might prevent the accident sequence. Likewise, merely instituting a defence or a buffer might have a significant beneficial effect on aviation safety.

By understanding psychological factors that influence behaviour in critical situations a basis can be formed for the development to alter that behaviour by addressing the underlying psychological influences (Hunter & Stewart, 2012). Thus it is important to take into account the human factors and interpersonal relation behaviour, resilience and effect of locus of control within a HRO where safety equates to life or death.

1.2 Problem Statement

In an industry that is already ultra-safe, a deeper understanding of the dynamics of human interpersonal relations, specifically in a cockpit environment (High Reliability Organization), may further enhance safety. The aim of this study is to investigate the dynamics of human interaction and human needs in a High Reliability Organization (HRO). More specifically, the objective is to identify whether there is a significant relationship between resilience and fundamental interpersonal orientation and secondly to determine if the behaviour that results from this orientation is moderated by a pilot’s locus of control.

1.3 Background/Motivation for the study

The researcher believes that the interaction between the three variables of this research (interpersonal relation orientation, resilience and locus of control) would enable one to develop a baseline on the prediction of behaviour in the HRO. In any complex socio-technical system that is encompassed by risk, it is the human element that bears this risk (Drury, 2013), which also results in the human element being blamed if such a system collapses. However, the human element should not be seen as the scapegoat to the loss. It is also the human element that keeps the system together in a time of discourse and results in a resilient factor for the system. Therefore, understanding the dynamic interaction of the human element and the shortcomings in interaction, individually and within a crew setting, may alter or develop the human element to not only be more resilient but also lead to a safer system.

1.4 Aim of the Study

Safer systems and HRO’s are dependent upon the human element - the crew. The crew serves as the central core of all processes and serves as the source of resilience (Dekker & Woods, 2010). It is however not just the co-locating of random individuals that result in a resilient crew. This study aims to develop an understanding of the complex nature of an individual’s locus of control (LOC) and its effect on the relationship between the interactional relations and resilience of a crew. The phenomenon of instinctive regression of humans to self-preservation in times of distress has the effect that team cohesion, resilience and efficient problem solving is lost (Alliger et al., 2015). Understanding the interplay of factors that will sustain cohesiveness as a protective factor in crew functioning may preserve the living system (Hearne, 2017). Hunter and Stewart (2012) and Thomas (2017) guide toward the potential of locus of control (LOC) being a predictive factor of human behaviour that can be applied to the full spectrum of human behaviour.

Thus, the aim of the research is therefore to understand how LOC may influence the interactive patterns of the crew in a demanding setting (the HRO) where fundamental basic human needs (interactive relation behaviour) are possibly withheld and its effect on the resilience of a crew.

1.5 Value of the study

Existing research suggests that a broad range of theories and models focus on engineering resilience in HRO’s, yet minimal focus is placed on building understanding of the individual or team (Alliger et al., 2015; Hollnagel et al., 2011). The present study not only aims to fill this gap within the existing research but also to add to the existing field of aviation research. Resilience of the living system is the core concept in proactive accident prevention, therefore, even the slightest better understanding of humans in a HRO can contribute to preventing the loss of life and hull**.**

1.6 Outline of Chapters

In order to investigate the research question and enhance the understanding of humans in the HRO, the following chapter will elaborate on the background and literature - covering the HRO, resilience, interpersonal relation orientation and locus of control. Chapter three describes the research problem and objectives as well as the design, sampling and data collection methods used. The measuring instruments that were used are discussed as well as the statistical procedures and ethical considerations. Chapter four covers the results of the current research. The last chapter includes a discussion of the findings as well as limitations of the current study and recommendations for future research.

CHAPTER TWO

BACKGROUND AND LITERATURE REVIEW

2.1 Introduction

The technological research and advancements of aviation in the 21st century have accelerated the human endeavour of flight into extreme and unusual environments. The advancements have led to the augmentation and development of ultra-safe, more efficient machines and systems with complex engineering structures (Guo & Sun, 2020).

Aviation is repeatedly viewed as the embodiment of progression and technological advancement within research and development. Concurrently, aviation is also the epitome of disaster (Baker, 2020). It is on this dynamic continuum between progress and disaster that the human factor of aviators is thought to account for the majority of calamities which are usually casually referred to as a pilot or human error. The evolution of the role of the human contribution to aviation safety is now at a critical stage of change precisely due to these advancements. Thus fully understanding how human performance builds and enables safe and efficient operations is crucial (Kiernan et al., 2020) and has become a highly popular research topic among aviation researchers. Against this background exist the search for new ways of pushing human performance limits towards successful handling of high stress situations (Socha et al., 2020).

Generally, human error has become almost somewhat of a scapegoat to explain incidents and accidents. Psychophysiological variables innate to humans, are viewed as the most pronounced causes of errors, and include fatigue, loss of communication, workload, stress and reduced cognitive abilities (Socha et al., 2020). Research however indicates that the cause of most flight accidents or unsafe situations are far more complex than just human error and that a number of interrelated factors contribute towards a disaster in aviation (Dekker, 2015; Irshad et al., 2020). Therefore, to try and find a baseline understanding of how specific interrelated factors may contribute to a loss in aviation, being familiar with the aviation context and the complexity of the interplay of the many factors that contribute to safety, is crucial. One such element is understanding the phenomenon of aviation as a High Reliability Organisation (HRO).

2.2 High Reliability Organisations (HRO's)

A high reliability system is a domain where errors occur rarely but where the consequences of any error are extreme. Furthermore the potential for failure is also high although the amount of actual occurring failures is low (Baker et al., 2006). This phenomenon qualifies aviation and specifically cockpit crew members as a High Reliability Organization (HRO) (Adjekum & Fernandez-Tous, 2020; Baker et al., 2006; Bourrier, 2011; Rochlin, 2011).

The HRO (or context), in which flight crews operate, forms a single entity of interrelated, highly competent and intellectual individual components that can be referred to as a living system, which operates in a complex socio-technical system (Adriaensen et al., 2019; Vieira et al., 2014). The living system (the crew) serves as the central core of all processes in the system, consequently highlighting human essence (Reason, 2000; Wesnser, 2015). Douglas A. Drury recapitulates with the following fundamental statement, "Any industry with an element of risk additionally has a human factor need as the risk is borne by the human conducting the task" (Drury, 2013, p.142). Čokorilo (2020) relates by definitively stating that the crew is the last line of defence to carry the risk but is therefore usually also blamed for the loss. Sikora et al. (2020) reinforce this by articulating that in order to survive any unforeseen and probable risky situation (anticipated or not) the greatest tool to have on an aircraft still remains a well-trained crew.

The risk that is borne and the consequences of disaster or success are shared by all members of the living system as a matched outcome, which results in an extreme form of symbiosis (McNamara, 2021). This interdependency of crews in systems operating in extreme environments is emphasized when success or failure, in some instances, may equate to life or death and this fate is shared by all members of the crew (Wagstaff & Weston, 2014).

The noted demands that have been placed on the human capability to adapt to faster and more complex machines, while saturated in an over-stimulating environment, cast light upon the shortcomings that exist in understanding and improving the social and psychological interaction and wellbeing of individuals and crews in the cockpit of an aircraft (Antonovich, 2008; Driskell & Olmstead, 1989; John Paul et al., 2010).

An International Civil Aviation Organization (ICAO) safety report (2019) confirms that there has been no significant change in fatal accidents in recent years (International Civil Aviation Organization [ICAO], 2019). With the continuation of loss of hull and life, more rules, regulations and Standard Operating Procedures (SOP's) have been written, refined and adapted to the highest critique in an effort to ensure the safety of the system. It is with this notion that Crew Resource Management (CRM) training was developed and crew training is now prescribed as mandatory by the International Civil Aviation Authority (ICAO) and the South African Civil Aviation Authority (SACAA) (ICAO, 2021).

With 70-80% of accidents documented as human induced accidents (Laukkala et al., 2018), the development of Crew Resource Management (CRM) training in 1976 was a step in the right direction. The first generation of CRM processes was however received with disapproval and informally baptized as "hot tub therapy" (Laukkala et al., 2018, p.94).

Airline pilots who underwent the training tended to disapprove of it because they perceived the emphasis on psychology as an attempt to change their personalities (Mouw, 2020).

CRM describes the effective management of all resources and the interaction thereof, which include the hardware, software, personnel and information within the aviation system (Helmreich & Foushee, 2010). Once introduced, a clear impact of CRM on the development of a safety orientation in flight crews was observed (Salas et al., 2001). CRM thus plays an integral part in aviation safety (Helmreich, 2006) and it is necessary to improve the efficiency of such training within aviation (Helmreich & Merritt, 2017). Mizrak and Mizrak (2020) went as far to conclude that CRM is a fundamental part of high performing crew safety.

With CRM developed 73 years after flight was born in 1903, understanding the human in the HRO is still infantile and more research is needed. To conceptually and genuinely understand the underlying psychosocial interplay of humans within a highly stressful environment, discovering and understanding the deeper level of functioning behind human behaviour is therefore important (Čokorilo, 2020). This stance was elaborated to include that team performance (Flin et al., 2002) and communication strategies (Kanki, 2019) also play a vital role in CRM.

Hence, within the new era, research within aviation understood that it had to shed light upon the limitations and dynamics of the social being in the HRO of aviation to further advance the impact of CRM on aviation safety. Furthermore, to understand the individual and his/her functionality in and as part of a team, the mechanisms of social behaviour had to be clarified (Drury, 2013).

To this effect research into the understanding of the human factor and the full range of his/her contribution to aviation safety has evolved tremendously in the last decades. From the early days of investigating simple cause and effect relations as in the foundational views to the proactive stance of resilient engineering approaches, understanding the human element in aviation has taken on fundamental changes and progress. These changes and progress will be briefly highlighted in the next section.

2.3 Approaches to the human element in aviation

2.3.1 The Foundation View

The foundational view boldly used the collection of systematic data on accidents and incidents to improve safety. This view highlights human error as the cause of system loss, searches for the individual at fault and aims to identify which individual component resulted in the lapse of functioning. The developmental path of understanding the role of the human element in aviation started by placing emphasis on failures. In this approach, more is known about the crew that makes errors and fails to manage these errors than is known about the crew that doesn't make errors (Kiernan et al., 2020). As a result, focussing on errors and overlooking successes can only tell part of the story (de Vos, 2018). Noted simply by Marit de Vos of Leiden University, it is if we are trying to learn about marriage by studying divorce (de Vos, 2018) as cited in (Kiernan et al., 2020). Other approaches needed to be considered in order to gain a better understanding of the contribution of the human element in aviation safety, especially the complexity of the psychological and systematic interplay.

2.3.2 The Engineering Approach

Since the foundational view found human error to be the cause of so many accidents, the flight industry's answer was to remove the "unreliable" human element, thus the engineering approach came to be. In the engineering approach, manufacturers and operators recommended that automation be used as much as possible. The argument was that use of advanced automation diminishes the disturbances and variations in the operation of the aircraft and increases the level of stability and reliability (Rankin et al., 2013).

Chialastri (2012) and Small (2020) state that automation at that time was to the benefit of this approach and that this driving force has been elemental in reducing the number of accidents. They continue by conceding that automation has solved longstanding problems but have also created new problems. However, a warning is noted regarding the hierarchical place of automation and its relationship to the pilot and the dependence of the human abilities without regard for automations limiting parameters.

In the new era of flight, automation has non-arguably found a place within the cockpit whilst also creating new impediments. In an investigation done by Landry (2017) he found that during 99.6% of all analysed flights of an international airline maximum automation was used. This focus led to an epidemic of loss of manual flying skills in aviators and has been deemed responsible for the loss of hull and life. The investigation into the loss of Air France 447 was confirmed as one such loss (Senol & Beyhan Acar, 2020).

Moreover, relying too much on breakdowns in the interaction between operators and automation has created an autonomous interface too complex to understand when partially lost or misunderstood, especially in a time of high cognitive demand on the flight crew (Leadens, 2020). This phenomenon was demonstrated by the Boeing 737 Max disasters (Herkert et al., 2020; Nicas et al., 2019).

Nevertheless, as time progresses accidents are still happening and the causes are still being ascribed to human error, even though continual new measures are set in place to make the system safer. Viewed from the engineering approach perspective most of these measures have consequently resulted in the over complication of an already complex system and drastically moved the focus away from empowering the core unit, which is the cockpit crew.

The paradigm minimized the role of the human and recently Shneiderman (2020) reiterated that human centred designs have to be designed to ensure that man and machine can form a symbiotic interphase.

Over the past decade the engineering approach has been reviewed and many human mistakes are now seen as design failures rather than necessarily distinct human errors. Additionally, research emphasis is now being directed to the interplay between man, machine and environment, specifically the contribution of the modern pilot and its innate human capacity.

During this phase of reviewing the engineering approach the modern pilot's role became increasingly more focused on risk management and system operations rather than traditionally being focused on the manoeuvring of the aircraft (Niehorster et al., 2020). Hence, the living system in the HRO is tasked with anomaly detection, higher level decision making, predictive estimation and planning as well as command regulation. In contrast, automation is assigned lower level tasks in order to handle variability and disturbances up to a level where disturbances exceed the automation's capability to handle and maintain control (Farjadian et al., 2020). Control is then transferred to humans, usually in a state of discourse (Rankin et al., 2013).

It is in this state of discourse during a crisis, while striving to get the system as a whole back into equilibrium that pilot's hazardous thoughts about the measures put into place by management regarding the legal consequences should there be any operations outside the prescribed limits, haunt pilots. Through personal conversation with an expert aviator, leader and coach in aviation training the researcher was made very aware that pilots perceive that an axe is held over their heads whilst fighting for the survival of the living system. He asserted that over-regulation and reprimanding measures are poisoning the core ability of the living system to operate. He furthermore stressed that being an expert with profound knowledge of the machine and the interaction with the environment will ultimately be more beneficial than being an aviation law expert with intricate knowledge of company reprimanding regulations (M. Compion, personal communication, September 2, 2020).

A recent study by Janssen et al. (2019), concluded that the answer to safer systems within the HRO may not be found in more automation, better software, redesign, more regulations and more pressures since the whole system is then set to become even more complex. The study asserts that automation will continue to progress significantly and the necessary interaction between machine and human will create more pressure on the crew, but humans will remain essential contributors with oversight regarding automated and artificial systems. The most recent report (2021) of the International Civil Aviation Authority (ICAO) argues that researchers recognise that attempts must not be made to replace humans with automation and technology. Rather, the human element within aviation systems must be supplemented by technology through human centred designs (International Civil Aviation Organization [ICAO], 2021).

The above-mentioned argument is reinforced by the persistence of accidents, even though the human element has been severely contained/controlled through automation. A recent report by Kiernan et al. (2020) concluded that it is of crucial importance to elucidate the need for more knowledge about the human element (defined by his/her perception, cognition and creativity) and show that it is still a central element to aviation safety. A comparative study by Rucker (2019) between general aviation and professional pilots found that there are psychological, cognitive and social factors that substantially influence effective crew communication and flight safety that need more investigation.

The move of the industry from its initial rigid engineering approach towards accepting the significant attribution of what the human element can give and how we should educate and engineer the human being rather than discipline and constrict its true capacity, is promising (Mizrak & Mizrak, 2020). Furthermore, the growing stance that the aviation industry must learn from the everyday successes, where things go right rather than emphasising only events where the result lead to accidents (which happens very rarely and therefore has limited data), must be a core drive to embracing the newest approach of the emerging field of resilience engineering (Tsuda et al., 2020). This moves the discussion from engineering the aircraft and its systems to engineering and educating the human element.

2.3.3 The Resilience Engineering Approach

The Resilience Engineering Approach in aviation postulates that humans are the reason that things go right and that the loss of a system is due to the system not being inherently safe. Furthermore, this approach states that the human factor is the differentiating element between those flights that perish and those where a novel solution was found to save the day (Dekker, 2015). The notion of James Reason (2000) expostulated and challenged the “old view” approaches by asserting that the only factor able to protect the dynamic uncertain aviation environment is human variability. Dekker and Woods (2010) elucidated by stating that human beings are the source of resilience in the complex system of aviation and thus, the reason that things go right. They continue by stating that it is only humans that can hold together the complex system that is slave to the interaction of patchwork technologies and conflicting pressure goals.

Hollnagel (2014) shaped the thinking of this approach by highlighting that the human element, (the crew) routinely prevents adverse events by continuously adapting their work skills to match the operating requirements of the system. A recent study conducted by Null et al. (2019) supports this belief by noting that system designers in HRO's should understand the performance variability of humans and what humans do well and then create a system with that in mind. Without the understanding of this full benefit, autonomous systems with adaptive human capabilities or optimized integrated human machine technologies, will not be comprehended (Kiernan et al., 2020). It is therefore of extreme importance to develop an understanding of the intricacy of human interaction and the human itself, as it is deemed the most complex element in the entire system and the central coordinator of all elements in the HRO (Mizrak & Mizrak, 2020).

The living system in a HRO can be regarded as a construction of a whole new social entity; the crew (team) as a whole becomes the work unit rather than the individual components themselves. The formation of such a living system is however not a given consequence of co-locating people in a group (Monfries & Moore, 1999). A team also does not automatically function as a synergetic system (Baker et al., 2006). Crew members confined to functioning in a specific team do not spontaneously have synergistic relationships. According to Sullenberger (2015), the cockpit should not be a team of experts but should rather be an expert team. In trying to understand and answer important questions regarding the interaction of crew members with aircraft automation and systems and with human elements such as fatigue or stress, emphasis must be placed on psychology (Rucker, 2019).

A substantial shift in the paradigm of thinking about aviation is needed to understand that, even in a highly professional, regulated and rational environment, human behaviour is driven by underlying bio-psycho-social factors. These factors can have either a detrimental or a performance enhancing effect on crew members functioning as an entity of unity. From the perspective of such a paradigm shift it is essential to no longer stimulate only intelligible information processing capabilities in crew members since most technologies have taken over this role. In a thought-provoking article by Lutnyk et al. (2020) it becomes clear that it is necessary to cultivate that which is essentially and uniquely human namely the capacity to be sociable and the formation of collective intelligence within the living system to fill in any gaps in order to improve safety within the HRO.

Social human interaction of a living system creates an entity that is, in theory, flexible and adaptable but robust enough not to lose its reliability and functionality (Hollnagel & Woods, 2006). Furthermore, it is an entity that remains dynamically stable and that is evolving rather than structurally inherent (Hollnagel, 2006). Humans have an adaptive capacity to accommodate unplanned change and to absorb disruption without reaching a breaking point – important in complex, high reliability systems such as aviation (Kiernan et al., 2020; Rosa et al., 2021).

A key factor that has emerged for safe and efficient operations within HRO's is resilience. Social entities (crews) have the intrinsic ability to be resilient (Kiernan et al., 2020; Rosa et al., 2021).

2.4 Resilience

The scientific study of resilience was born in the 1970s when researchers strived to understand the prevention and development of psychopathology among individuals. It has since grown into a multi-level field of knowledge, which spreads from intracellular to non-human ecosystems and economies (Chapman et al., 2020). The definition and operationalization of the concept of resilience has been somewhat ambiguous in the literature to date, with no shared definition that reflects its complexity, much less its multisystem influences (Ungar & Theron, 2019).

The complexity in defining and operationalizing resilience is demonstrated in a study by Meredith et al. (2011) as cited in Teng et al. (2020), who reported 104 different definitions. As a result of not reaching consensus in the definition as well as operationalization or measurement of resilience it is clear that the body of knowledge is still in an infantile phase (Cheng et al., 2020; Pruchnicki et al., 2019).

The foundation of resilience was set on the notion that adversity is inherent to system performance (Bonanno, 2004) and that adversity encompasses challenges, setbacks, stressors, and pressure (Chapman et al., 2020). With these aspects in mind resilience is generally conceptualised through the interdependence of units, the cross level interaction of systems and the context of the specific environment (Masten & Cicchetti, 2016). Furthermore research indicates that resilience can be comprehensive across various occupational settings to different systems and different levels within a system and is therefore regarded as complex and malleable in nature (McCray et al., 2016).

Hence, although there seems to be no conclusive definition for resilience, many studies (Masten, 2001, 2014; Masten & Motti-Stefanidi, 2020; Rutter, 2012) have viewed resilience as the ability of a system (like a society or individual – the flight crew and its crew members) to continue functioning normally despite the occurrence of significant stressors.

Recently, Ungar et al. (2021) suggested a novel definition by motivating a shift from the perspective of resilience being an innate character trait to explaining resilience as a process that includes interfaces arising within and among multiple systems, shifting from individual biology to psychological, sociocultural, relational, institutional and ecological mechanisms that create the potential for society under stress to do better than expected. They continue by stating that being resilient does not only entail recovering from adversity, but also the ability to sustain functionality and thrive in a newly formed system. Theron (2020) stated that the current understanding of resilience favours the social ecology and the individual contribution to the process of resilience. This facilitates resilience through collaboratively exchanging and engaging with contextual and systematic resources as well as individual level resources.

The definition that will be used in this study that is in favour with the current thinking consists of a combination of the following two definitions. The first and most prevalent (Chapman et al., 2020) was defined by West et al. (2009) as "the capacity to bounce back from failure, setbacks, conflicts, or any other threat to well-being that they may experience" (p. 253). The second has been identified by Chapman et al. (2020) and was defined by Morgan et al. (2013) as, "a dynamic, psychosocial process which protects a group of individuals from the potential negative effect of stressors they collectively encounter. It comprises processes whereby team members use their individual and collective resources to positively adapt when experiencing adversity" (p. 552). The focus of resilience in the present study is understanding how crew members can be resilient as a team by anticipating, recognising, monitoring and responding by adapting or resisting changes or dysfunctions in the operational theatre. This is in addition to absorbing a surprising threat or disturbance that falls outside of the system's design parameters or the crew's training (Foster, 1993; Hollnagel, 2009; Kendra & Wachtendorf, 2003). In aviation, resilience serves as a buffer for that which cannot be anticipated. This enables human resourcefulness and is explained as "thinking in action" (Tierney, 2003). It can thus be reasoned that resilient crew members display characteristics of creativity, rapidity and spontaneity (Folke et al., 2010). These make the system flexible and adaptable, yet robust enough not to lose its reliability and functionality (Hollnagel & Woods, 2006). More specifically, in the HRO being prepared to be unprepared is to be resilient as it employs a comprehensive defence against unexpected events (Furniss et al., 2011).

In aviation HRO flight crews are constantly presented with environment-specific surprises to which they must respond in an appropriate manner (Agha, 2020). These surprises result in crews having to make trade-offs through evaluating competing information and signal overload while being placed under pressure by complexity and time which in turn affects mental processes (Pruchnicki et al., 2019). Through anticipation the crew is then able to “stay ahead of the aircraft" and make sense of all the incoming information. Resilience is thus a proactive approach with pre-emptive processes of adjustment which lies in the intrinsic ability of a team (Macrae, 2019).

Macrae (2019) continues by stating that resilience entails the ability to rapidly mobilise social technical resources, to respond to an environment-specific disruption through dynamic interaction of individuals in a crew. A study by Höltge et al. (2021) exemplifies by stating that the capacity of an individual or group is facilitated by the interaction of resilience — enabling processes and their ability to draw on resources which include personal resources and social ecological resources.

Flight crews are faced with unique environment-specific surprises every day. With systems that become more complex and unpredictable, failures in flight are evidently more unique and flight crews are therefore challenged with the responsibility of creating novel procedures in handling surprises that were beyond their prepared abilities, through resilience (Hollnagel, 2017). In most cases a crew was deemed as resilient when the individuals in the crew were not trained in the specific event but they still managed to re-establish equilibrium within the system — as illustrated in Qantas Flight 32 (Australian Safety Transport Bureau, 2013) and Flight 232 (National Transportation Safety Board, 1990).

With the complexity that the industry faces, the “Blame and Train” approach (Macrae, 2019) will no longer prevent accidents and researchers regard resilience as the one key skill that needs to be developed (Dekker & Pruchnicki, 2013; Hollnagel, 2017). Adverse events can cause breakdowns in the complex nature of flight crew interaction which can result in the breakdown of the whole system (Pruchnicki & Dekker, 2017; Reason, 2016). The whole system, as well as subsystems (interacting crew), operates in the envelope of "safe operations" with continual fluctuations as it adapts and absorbs the interaction of all the components (Hollnagel, 2009). The accumulation of small events, and seldom one big event, can cause the system to move out of the safe operation envelope. If the system is able to adapt and no longer only absorb the event but develop a new state of stability it can be regarded as resilient (Pruchnicki et al., 2019).

Due to the dynamic nature of the environment in which environment-specific crews operate, it is seldom that manuals, rules and regulations can make provision for all possible unexpected events. Any shortcoming of the system thus has to be balanced by the flight crew whose presence of mind should ensure that an incident does not result in calamity. Therefore, it is the team that brings resilience to the system. A situation may occasionally necessitate a crew to abandon specific procedures completely (Hollnagel & Woods, 2006; van der Lely, 2009). However, in general it is expected that a resilient crew is aware of its safety boundaries and anticipates when the system will operate outside of its parameters. The crew must continually remind themselves that past success is not a guarantee for future safety and that risk must be seen as an element that is alive and continually adjusting and evolving (Dekker, 2006). It is therefore of cardinal importance that fixation is avoided and that similarities to past experiences are reinterpreted and a sensitivity to the current context is fostered (Dekker & Lundström, 2007).

In HRO systems resilient acts are mostly unheard of, as crews handle numerous surprises without it becoming catastrophes. All flights are faced with surprises that are handled and therefore seen as non-events. Handling such unexpected events should therefore be seen as successful outcomes achieved by resilient crews and it must be studied and reinforced. Positive behaviour must be reinforced and resilience must subsequently be trained and exercised (M. Compion, personal communication, September 2, 2020). Noted by de Crespigny (2018), resilience develops through continual learning and deliberate practice and it is fundamental that small victories and successes are used as building blocks to become a resilient flight crew. These small victories equate to approximately 98% of all flights, averaging at about four per flight (AGCS, 2014).

It can be deemed impossible to prepare the crew for every possible unexpected event (Dekker & Pruchnicki, 2013). It would however be reasonable to consider that a crew can be equipped with a set of skills that can be applied to most events and its variables. Pruchnicki et al. (2019) direct us to the promotion of resilience in order to develop this skill set. To promote resilience is to train pilots in understanding emotional upsets and adjusting to not only the upsetting event but also to the dynamic social and socio-technical interaction of the direct environment (Macrae, 2019).

In order to promote resilience the mobilization of resources must be prioritised through the application of defined patterns of interaction and social knowledge that will keep the crew functioning as a whole. This knowledge must be practised in training (Pruchnicki et al., 2019). Martin (2019) supports this statement by advocating the development of resilience through the training in unexpected events. In addition Field and Lemmers (2015) stress the training of social awareness when communicating and being in tune with empathic accuracy. Grotan et al. (2015) add that teaching mindfulness and the appreciation of openness to admitting mistakes and standing with readiness to be corrected followed by mutual support will promote resilience. Overall, promoting skills, characteristics and attitudes that foster resilience potential to develop will in turn enable human resourcefulness and aid holistic crew functioning. (Hollnagel, 2017; Tierney, 2003).

The formation of a resilient living system or team is however not a given consequence of co-locating resilient people in a group (Monfries & Moore, 1999). Limitations in previous research recognize the importance of assessing the inter-dynamics of High Reliability Teams, specifically on a more in depth human level and within the career specific context (van der Kleij et al., 2011).

Several factors need to be accounted for to ensure the resilience and reliability of the team. Resilience is slave to risk factors or protective resources (Masten, 2001, 2018) that predict undesirable vs desirable outcomes. These include factors such as psychosocial competence, self-esteem and human needs (Prince-Embury, 2014; van Rensburg et al., 2015).

Orsanu (2010) found that when placed under pressure, people regress to their most habituated need, which is self-preservation. This phenomenon of instinctive regression results in the effect that team resilience and problem solving is lost in favour of individual focus and survival (Alliger et al., 2015). Even though the capacity to be resilient is rooted within a bond of secure (close attachment) relationships, it cannot be attributed to one specific factor. These predictors are referred to as protective factors (Prince-Embury, 2013), which are personal qualities that exemplify resilience. Such protective factors include, among others, sense of control, cohesion, attachment and intimacy (Prince-Embury, 2013, 2014; Southwick et al., 2014; van Rensburg et al., 2015).

Masten (2019) continues by noting that the capacity of an individual to adapt to challenges depends to a large extent on their connections to other people and systems external to the individual through relationships and other processes. Ungar et al., (2021) concurred that resilience as a behaviour is not the product of one aspect of an individual’s life but rather facilitated at multiple levels through various promotive and protective factors and processes. Theron (2020) explores this more in-depth by unravelling the individual resources that contribute to resilience such as motivational factors, cognitive competencies, emotional stability, behavioural and social skills and physical wellbeing.

In general, loss of the multi-level social interaction or relationships subsequently lead to a loss of a sense of cohesiveness and will not only affect team members' wellbeing negatively, but also drain the resources needed for the team to be resilient. The disposition to function in a team is a fragile phenomenon. In challenging environments and adverse situations, the dynamics in a team can change abruptly. Losing the sense of being a team will untimely regress the living system into isolated units, which can also be referred to as the loss of cohesion. Cohesion is the essential component that binds different units (individuals) together in order to create a team that has the ability to be and react resilient (Rosh et al., 2012).

Cohesion is therefore the "glue" that integrates the individual components to form a single, high-functioning unit — the team. Alliger et al., (2015) have similarly indicated that if team members lose their sense of team they tend to become more individualistic and self-focused. This will result in loss of effective team performance, hesitant communication and severe negative outcomes that have previously resulted in fatal disasters in aviation. Cohesion, although a protective factor, in HRO teams is however easily eroded by any form of pressure (Alliger et al., 2015; Heese et al., 2013; McLeod & von Treuer, 2013) leading to its demise. The research furthermore indicates that cohesion was also found to be embedded within intimacy (a protective attachment bond) and individuals' orientations towards intimacy mediate the drive for need-gratifying behaviour (Rosh et al., 2012) that risks the adaptation of the living system, during unexpected situations.

Intimacy as a construct varies greatly in conceptualization depending on the framework it is being used in. In this study the accepted conceptualization of intimacy is that of a fundamental basic human need, characterised by interactive relation behaviour (Sullivan, 1953). In Sullivan's seminal work on interpersonal theory (1953) he views this basic human need as a multicomponent, transactional process that facilitates interpersonal communication, openness, trust, validation, affect and social identity. It further encompasses a person's environment, communication, thoughts, feelings, interactions and relationship commitment (Rosh et al., 2012). In the context of aviation and the HRO, intimacy must be comprehended as the degree to which every individual is intertwined in the fulfilment of social, emotional and psychological needs that will preserve the living system (Berscheid et al., 1989). Thus to truly comprehend resilience in aviators within the HRO the connection with interpersonal relation characteristics of aviators will be discussed as this seems to be a crucial protective factor in keeping the crew resilient.

2.5 Interpersonal Relation Behaviour

Interpersonal relations behaviour is grounded in theories regarding basic psychological needs and self-determination that explain the motivation for human behaviour. One such theory, Basic Psychological Needs Theory (BPNT) conceptualizes relatedness together with competence and autonomy as innate and essential for human functioning and wellbeing (Fraguela-Vale, et al., 2020). The body of knowledge regarding psychological needs, both seminal i.e. McClelland (1965) and more recently (Ryan & Deci, 2020) agree that individuals are driven to satisfy their psychological needs. Moreover, recent research on basic psychological need theory (Soenens et al., 2020) noted that the fulfilment of psychological needs is not only necessary, but more so critical to the functioning and wellbeing of the individual.

Schutz (1985) and his Fundamental Interpersonal Relation Orientation (FIRO) theory states that the key motivation of human interpersonal relations lies with the fulfilment of social primal needs. In addition, a defining study by Romaine (2012) concluded that psychological relational needs will drive individuals' interpersonal and social behaviour because psychological and social needs are generally satisfied through relational exchanges. More clearly explained, humans are constantly analysing social interactions to evaluate the state of their own survival or wellbeing in terms of the availability of resources to fulfil their needs. An individual's personal evaluation of his/her "survivable state" affects his/her perception and appraisal of the environment and all aspects of the interaction (You et al., 2013).

People furthermore have a need to *share* their social self. This need is driven by basic instincts to socialize and interact (Gaur, 2019). Interpersonal relationships are formed between individuals where individuals take their own behaviour into account in consideration for the other person involved in the relationship. Any expectation created is likely the result of individual behaviour and individuals will orientate themself according to others' as well as their own need for interaction. Schutz (1958) asserts that the fulfilment of basic social needs are focused on finding relational equilibrium — and not unlimited gratification.

The Fundamental Interpersonal Relation Orientation (FIRO) theory of Schutz (1958) provides the theoretical framework for conceptualizing specific social needs in this study. He postulated three social primal needs, namely the need for inclusion, need for control and the need for affect/openness. Inclusion indicates the need to be included into social settings and is referred to as the need to maintain relationships. The need for control refers to the balance of influence within relationships, specifically, the control that is expressed or wanted by oneself. Lastly the need for openness or affection refers to the degree of intimacy or closeness in personal relationships. In his seminal work on interpersonal behaviour he asserts that individuals will seek to negotiate the wanted and preferred balance between inclusion, openness and control expressed toward them. However, too much or too little gratification of these social psychological needs can lead to dissatisfaction and unfulfillment in the individual. Temporary discontent can be overcome, but prolonged dissatisfaction can lead to the loss of motivation, heightened anxiety and mental illness. Schutz (1958) concludes that when interpersonal needs are not met, individuals might activate defence mechanisms with a focus on self-preservation.

It is therefore essential to satisfy these basic needs since actualization of potential lies in its availability (van den Broeck et al., 2016). Deci et al. (2017) continue by asserting that the satisfaction of basic needs (including the need for relatedness or belongingness), as well as an environment that supports it, serves as a driver for being motivated and acts as a fundamental facet of psychological wellbeing as well as enhanced operational performance in social situations. In a study on organizational effectiveness Koster and Bloem (2018) confirm that good interpersonal relations enhance innovative performance. The formation of harmonious relationships and the maintenance of social resources is a critical resource for resilience and the satisfaction of relational needs (Baker et al., 2020; Tabibnia & Radecki, 2018). Relational uncertainty decreases relational satisfaction (Canary & Dainton, 2003) and can result in a decrease in flow of information and less open communication (Theiss & Solomon, 2006) within the cockpit of an aircraft.

It was found in terms of functionality that relationally secure individuals react more effectively to stressful situations through relational tactics in challenging environments (Mikulincer & Florian, 1998). These individuals are more likely to engage in and express the need for support and contribute to a situation that requires social interaction. They are also more willing to invest personal value and vulnerability into a team in order to be immersed within the team (Robijn et al., 2020). In contrast, relationally unsatisfied individuals would rather maintain independence; placing greater importance on self-fulfilment than relational survivability (Guerrero & Jones, 2003).

In an important study by Shrivastava and Burianova (2014), the authors found that decreased levels of relational satisfaction will lead to the possible withholding of crucial information in a situation that needs communication, lower levels of commitment and the neglect of support. Furthermore, such individuals seem disproportionally sensitive and more reactive to unexpected surprises with the tendency to resort to hopelessness more rapidly. The psychological effort associated with disconnectedness, drains individual resources and "snowballs" the feeling of relational insecurity. Individuals then fake, amplify or suppress emotions in the interest of interpersonal acceptance which result in emotional labour as there is incongruence between the inner self and outer behaviour. This hinders the human capability to act resilient (Shrivastava & Burianova, 2014).

Within the HRO, the social interaction between aviators is constantly under ubiquitous threat. If not maintained and controlled it may cause the crew to regress to a pursuit for the maintenance of their survival, regardless of their functional task. In a cross-cultural study using the FIRO-B, Ditchburn and Brook (2015) found that the loss of the need for openness is predominantly the initial element lost.

In the present study the FIRO-B scale of Schutz will be used to operationalize and measure the interpersonal relation orientation of openness, inclusion, and control in aviators. Openness enables communication, trust, self-efficacy, interrelatedness and a shared common goal. The need for openness is defined by Ditchburn and Brook (2015) as the feeling of closeness and comfort in interpersonal relationships with others. The construct relates closely to the conceptualization of intimacy that was found to be vulnerable to the loss of the benefits that openness brings such as interpersonal communication (Section 2.4). The optimization of openness can be achieved through providing the social resources which will lead to the experience of psychological safety and trust in interpersonal interaction (Shrivastava &

Burianova, 2014) and ensure that individuals have the optimal level of orientation towards fulfilling social needs (Berscheid et al., 1989).

This feeling of psychological safety (a crucial attachment and basic need in individuals) will ensure better information sharing and higher synergy and therefore improve team effectiveness. Thus it further allows for the development of strong interpersonal relations and reduces the likelihood of conflict (Langfred, 2007); is essential for the emergent state of cohesive team dynamics; and is crucial for information exchange. A study on needs, intergroup conflict and performance asserts that openness develops the comprehension of interpersonal orientation and the awareness that collaboration in the attainment of limited resources is more successful in dealing with adversity than the individualistic pursuit for survival (Chun & Choi, 2014).

Siegel and Miller (2009) in a study using the FIRO-B instrument further found that individuals possess a desire to belong and to be accepted by others. This is understood as the need for inclusion, which serves as the resource of social interaction for group members. In Shultz’s seminal work on the FIRO-B he viewed inclusion as the need to form and uphold acceptable and relaxed psychological relations either with individuals known by association or with individuals through interaction. He asserts that individuals need to feel acknowledged and identifiable; that they are important and worthy in order to satisfy the need for inclusion (Schutz, 1958). Inclusion thus involves behaviour that either demonstrates a need for belonging, association, companionship and comradery or on the other end of the scale for detachment and being ignored. Individuals with a high need for inclusion are often viewed as “prominence seekers not dominance seekers" (Schutz, 1958, p21).

Eliciting psychologically comfortable behaviour from an interaction refers to the need for control. It is based upon the preservation of mutual respect for the self and the other individual, as well as the responsibility of competence. The need for control is rooted within authority, influence, power and dominance and is deemed of special importance in a hierarchical team setting. Not wanting to be controlled will result in unwillingness to comply, rebellion and the demonstration of independence (Schutz, 1958). The fulfilment of these mentioned needs result in a relational equilibrium which serves the preservation of the sense of team.

Relational equilibrium also serves as a buffer for the loss of cohesion. When a living system is under stress the relational equilibrium will make up for and create a buffer against the social void formed within the team. The loss of cohesion in a team will result in behaviour driven by survival (Orsanu, 2010). Harms (2017) stated that psychological needs are fundamental drivers of human behaviour and humans seek to align their behaviour with the need to satisfy the social void through interaction and compatible relationships. Survival driven behaviour will directly eliminate the resources needed to be resilient. With the high interdependency between crew members, the rise of an emotive state within the dislodged team will result in affective self-reliance and a complete loss of team resilience. With the loss of the sense of team, crew members will become vulnerable as sensory, cognitive and emotional experiences are intimately intertwined and inseparable (Zillmer et al., 2008).

With emotional responses being a two edged sword, emotions can either be expressed as overwhelming behaviour resulting in chaos or as emotional regulation or suppression due to acceptability — both of which tax cognitive functioning and worsen interpersonal effectiveness (Agha, 2020). Even though emotions are common features in our daily lives, the HRO environment amplifies responses and directly influences relational equilibrium, either negatively or positive. This makes understanding an emotional response a requirement for stable interpersonal interaction. Emotions give us information about our surroundings that is vital to our survival (Caruso & Salovey, 2004). When humans operate in a society, or any social context, emotional understanding is deemed a crucial factor for success. Emotional regulation through interpersonal relations in high performance teams (such as in aircraft) is an aspect that must be malleable by crew members to avoid depersonalization, emotional contagion and shared invulnerability (Wagstaff & Weston, 2014). To enhance the understanding of emotional malleability in a team, individual needs will have to be encapsulated as an overall relational exchange on a continuum. The exchange must maintain the balance of the needs to ensure a symbiotic relationship between members (Schutz, 1958).

Theoretically, crews are encouraged to develop mutually dependent attachment bonds where all members have the confidence to express themselves and have the belief that they would be heard and psychologically safe. The shared task/goal, with the certainty of being heard, then develops into an interactional pattern that would be a critical factor to the whole social climate in the cockpit. The system is however not always set to be in favour of satisfying human needs. This is due to the dynamic rate at which flight crews are altered in the different settings, might it be in a scheduled airline (every flight has a change in crew) or a flight school (for example the changing between instructors). The dilemma that follows is that crews can suffer from an innate occurrence called the shame-effect (Brown & Moren, 2003).

The shame-effect is an elemental emotional factor that has been developed through human evolution and advancement. It is a dynamic and automatic response triggered by new situations, unfamiliarity and conflict without secured social bonds between individuals (Brown & Moren, 2003). Without conscious intent a coherent emotional response is created to serve as a braking system to modify spontaneous behaviour in order to maintain safe interpersonal levels. It drives a regulatory buffer to any social interaction — might it be a potential threat or an attractive novelty. It causes an immediate stagnation of openness and fluid interaction between crew members. It is usually visible through political correctness, tact and extreme professionalism (Brown & Moren, 2003).

It is of cardinal value to understand and navigate these emotional responses linked to loss of satisfaction of interpersonal needs to ensure psychological safety, relational equilibrium and altering the driving force or motivation behind the behaviour (Hunter, 2002; Özkan & Lajunen, 2005). Individuals are motivated to satisfy their social and psychological needs (Schutz, 1958). It is however paramount to understand the extent to which an individual perceives themselves in control of their action to satisfy those needs (Rotter, 1966). Woods (2020) bridges the gap and links Rotter's social learning theory to the aviation domain by noting that certain individual motivational factors imprint heavily on crew interaction and pilots' decision making.

In the search for suitable ways to understand perceived behavioural control research indicated that locus of control (LOC) is a viable predictor of human behaviour and can be applied to the full spectrum of human behaviour (Thomas, 2017).

2.6 Locus of control

Rooted in the social learning theory, the belief that a person's behaviour determines consequences either as an active agent, by being master of their own fate or by a function of chance, gave life to Julian Rotter's theory of locus of control (LOC) (Thomas, 2017). Rotter proposes that for any given psychological situation, the potential for a specific behaviour to occur is based on the function of the expectation that the specific behaviour will lead to the expected outcome and that the outcome is deemed of value to the individual (Carton et al., 2021). Carton et al., (2021) continue by stating that the potential that behaviour will occur is explained through three basic variables. First is expectancy, which is the belief that the outcome is dependent upon a set of behaviours. Secondly, the reinforcement value of the outcome and lastly, the contextual situation and the individual’s subjective interpretation thereof.

Rotter's theory conceptualized LOC using a single (unidimensional) factor continuum construct where LOC refer to a perception regarding the extent to which an individual attributes the outcome of a life situation to be either under his/her own control (a belief in internal control) or under the control of an external, situational factor (external control) (Dave et al., 2018; Rotter, 1966; Thomas, 2017). When operationalized, measuring LOC will yield a single general LOC score that may range from an extreme external LOC orientation to on the other end an extreme internal LOC orientation (Hunter, 2002). As a construct locus of control has been used to predict outcomes in a plethora of populations and context specific environments such as health, safety, sales, academic performance and many others (Turnipseed, 2014).

Of specific interest for this study is the emphasis placed on researching locus of control in relation to different high reliability organization (HRO) contexts such as, i.e., nuclear power plants, aviation, and health. Research conducted by Tangatarova and Gao (2021) focused on nursing staff who operate in risky circumstances with a high stress load and an urgent response environment, where emotional coping and making the right decision in minimal time is of the essence. In the context of a HRO where an individual's behaviour carries personal responsibility for people’s and/or system safety, it is of essence to understand what will predict or motivate certain behaviour.

The application of locus of control as a viable predictor of human behaviour with specific reference to the context of aviation was validated by various research studies (Hunter, 2002; Hunter & Stewart, 2009). It was furthermore established that LOC is highly correlated to aircraft accidents (Dave et al., 2018; Hunter & Stewart, 2012; Joseph & Ganesh, 2006). The inability to delegate control and responsibility might be detrimental as the HRO context is too complex to handle solely without entrusting control to automation and other crew members (Chiou et al., 2021). Based on Rotter's (1975) notion that prediction of locus of control in very specific environments requires assessments to be tailored to such an environment (Hunter & Stewart, 2012) Hunter set out to develop a questionnaire for operationalizing locus of control for aviation safety. He adapted Jones and Wuebker's Safety LOC scale to assess internality – externality specifically for pilots (Hunter, 2002). He developed two approaches to scoring that yield both a one-dimensional, combined framework score such as that of Rotter and a multi-dimensional score. In the multi-dimensional approach, he explains locus of control by illustrating it as expanded on two separate control continuums: one continuum of internal (I-LOC) and another of external (E-LOC) reinforcement. The continuum expands from low to high for both internal and external LOC.

Explained, an individual is either responsible for the consequences as an active agent of reinforcement or as a function of chance in which an unpredictable outlying source is viewed as in control of the individual's behaviour (Hunter, 2002). Hunter continues to explain that individuals who are externally driven will not strive to achieve active reinforcement in the future. In contrast, those with an internal control will attempt and continue to alter their behaviour to achieve the desired need or outcome.

Research using aviation specific measures of locus of control was able to link external and/or internal locus of control to many behaviours and characteristics of individuals that either promote or erode safety in a variety of contexts and populations. Research into safety orientation and accident involvement in aviators showed that individuals with higher E-LOC are linked to less precautious behaviour, lower levels of self-confidence and self-efficacy and have a negative disposition towards a safety orientation (Hunter, 2002; Joseph et al., 2013).

They also found that in chaotic situations individuals with E-LOC demonstrate rigidity to dynamic solutions and an active avoidance to admit to social vulnerability and taking responsibility for outcomes. Furthermore, social critique and demanded self-evaluation of high E-LOC individuals can lead to passive aggressiveness in interpersonal interaction. These individuals are less likely to embrace recommendations from the fellow crew members, which will result in the loss of cohesion in a team environment (Nykänen, 2020).

On the other side of the continuum, individual aviators with an I-LOC were far less involved in accidents. Their behaviour played an important role in safety motivation and was linked to proactively avoiding hazards and consciously connecting with the team in order to enhance safety (Dave et al., 2018). Furthermore, individuals with an I-LOC were found to embrace a commitment to change their behaviour through the acceptance of challenges and persevering in the face of adversity (Rice et al., 2020). Tangatarova and Gao (2021) continue to bolster the understanding by asserting that individuals with I-LOC are more likely to be innovative and constructively develop non-traditional solutions to situations that require “out of the box” thinking. They solidify by stating intrinsic motivation has long so been regarded by scholars as a proximal predictor of creativity and innovative behaviour.

Investigating safety and risk perception in the aviation context LOC was found to have a significant relationship with risk perception (Tangatarova & Gao, 2021) and dealing with risk. You et al. (2013) concur by stating that individuals with an I-LOC are more concerned with safety operation behaviour and can be regarded as having a better risk perception and readiness to adopt an active role in high-risk situations. Accepting responsibility and taking initiatives in mitigating it through associated behaviour is a crucial element in resilient HRO functioning. From a somewhat different perspective a study linking the trait of emotional intelligence to safety in aviation it was argued that individuals with higher personal responsibility feel more in control of their work (I-LOC – personal interpretation) and are also more motivated to align themselves with safety orientated behaviour (Dugger & McCrory, 2021).

However, Martinussen and Hunter (2017) reported that both internal and external locus of control impact risk perception and that LOC in general is vital to the understanding of aviators' level of risk perception (Nuhu, 2019). On the one hand it was reported that aviators with a higher I-LOC (of the opinion that they are experienced and skilled) will take continuous risks as they expect their behaviour to be successful in eluding accidents. One the other hand, aviators who take fewer risks because they perceive outcomes to be above their skill-level and too difficult (thus with higher E-LOC) will take fewer risks. These individuals do not strive to gain rewards in future situations, nor do they expect rewards from their own actions. Individuals with higher E-LOC also tend to perceive risk factors as unrelated to their own choices and therefore feel less control over the situation which on the positive side increases their risk perception and decreases their participation in risky behaviours (Tagini et al., 2021).

Viewed from the perspective regarding the importance of interpersonal relation orientation behaviour for the functioning of aviators in the cockpit, the study by Agbajemebe et al. (2018) provides crucial understanding. They found that individuals with I-LOC have better conflict resolution skills and handle conflict in a more peaceful and positively orientated manner. They attribute this to taking true ownership of controlling one's emotional state and responses. This is also verified by the significant correlation of I-LOC with emotional intelligence that they found.

Nykänen (2020) furthermore explores the functionality of I-LOC and conceptualises it as a changeable psychological characteristic that can be modified. He pieces together the extensive effect that I-LOC has on promoting safety by setting down the fundamentals of its importance. He asserts that I-LOC reflects the expectancy of outcome and perceived likelihood that effort will lead to effective performance and accident prevention. It was found that I-LOC individuals learn through failures and are driven by self–exploration and information seeking behaviour which reinforces their expectancy of outcome and therefore their resilience (Kilic & Soran, 2019).

An association between LOC, resilience and aviation safety has also been established in literature. Not only does resilience improve aviation safety but believing that we can directly influence events around us (I-LOC) improves resilience (Georgescu et al., 2019). I-LOC was established as a main factor influencing resilience (Garmezy, 1993; Werner & Smith, 1982) and Edwards et al. (2016) noted that I-LOC was an independent predictor of resilience. In a study regarding factors of trauma resilience Rizkia and Kusristanti (2020) reinforce the importance of the relationship between LOC and resilience by stating that LOC serves as a significant protective factor of resilience.

The earlier discussed section on the engineering resilience view in aviation mentioned that resilience also refers to knowing when to delegate control to automation. According to a study done by Syahrivar et al. (2021) drivers with high I-LOC might have difficulty delegating control to automation. This may also be applicable in aviation as Chiou et al. (2021) reported that a discoherence in the trust of automation and autonomous assistance degraded the performance of aviators with high I-LOC. Interestingly, most commands were given by high I-LOC individuals, which illustrates their frustration if not directly in control. These individuals might find it hard to adapt to being in a more monitoring role than actually flying the aircraft, which can also affect their ability to delegate control to other crew members (Syahrivar et al., 2021).

Regarding flight hours and age (implicating experience) as factors that influence safety in aviation, Hunter (2002) found that the relationship between flight hours and LOC (internal and external) was not statistically significant, however the correlation between internal and external LOC and age was significant. Consequently he argued that aviators become more internally oriented as they age and that more flight experience did not bring about a change in aviators' orientation.

In conclusion, although it may seem from the preceding discussion on locus of control that internal locus of control is to be preferred in the context of aviation, it must be noted that internality should not be always regarded as "good" and externality as "bad" as the spectrum of influence is too significant to classify it as such. Rizkia and Kusristanti (2020) provide evidence of the positive significance of E-LOC by illustrating that individuals with high E-LOC serve as better social support buffers and as emotional resources and reveal that they are more prone to accept interventions. Recent research however also shows a significant negative correlation between high E-LOC and resilience (Türk-Kurtça & Kocatürk, 2020). Furthermore, low E-LOC has been associated with an improved ability to tolerate external pressure, inner feelings of independence and a more effective response style while facing adversity (Balazadeh & Hansson, 2021).

2.7 Summary

Aviation has developed into a domain regarded as a centerpiece of modern civilization. It is usually praised or criticized to the utmost extent for successes and, more prominently, failures. It is loosely painted in the literature that human error is responsible for 70-80% of accidents (Laukkala et al., 2018). However, it is the human element that carries the burden as it serves as the central core to keeping the whole system together and bearing the risk. With deeper analysis and understanding researchers realized that the human element is a resource to harness and the reason that things go right (Dekker & Woods, 2010).

The development of CRM and the maturing of the various views on human error has resulted in an understanding that the crew is the core source of resilience. Resilience serves as the buffer to a system that operates within an operational envelope and if the system is disrupted it has the capacity to resist, adapt or transform itself into a new system to ensure that functionality is not lost. It is in this system that highly skilled individuals come together and need to function as a cohesive crew. The crew must function as a collective unit to ensure its success. Nonetheless, co-locating people together does not ensure a synergetic team with individual components serving as resources to each other. It is in this collective setting that the understanding of individuals' interpersonal behaviour orientation comes into play. Psychosocial needs serve as the fuel for interpersonal interaction.

If these needs are not met individuals tend to regress to self-preservation and cohesion and cooperation is lost. Humans are driven to satisfy their basic human needs more so in a highly stressful environment which amplifies survival and therefore regression to a focus on the self. It is with this notion that LOC serves a fundamental purpose in understanding the continuum of the motivation of action in human behaviour and therefore a baseline of prediction of human behaviour.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The following section portrays the research problem and objectives and research design and approach of the current study, sampling methods and participants, the data-gathering procedure and measuring instruments, statistical procedures and the ethical considerations that are relevant to the study. Thereafter follows a discussion of the statistical analysis applied to the data.

3.2 Research problem and objectives

In an industry that is ultra-safe, a deeper understanding of the dynamics of human interpersonal relations, specifically in a cockpit environment (HRO), may further enhance safety. The aim of this study was to investigate the dynamics of human interaction and human needs in the HRO in aviation. More specifically, the objectives were to identify whether there is a significant relationship between resilience and fundamental interpersonal orientation of pilots in aviation; and secondly to determine if the behaviour that results from this orientation is moderated by a pilot’s locus of control.

3.3 Research design and approach

To answer the research questions a quantitative research approach, of a non-experimental type has been employed. Non-Experimental research is valuable when a researcher is interested in observing and describing a phenomenon as well as measuring constructs within the phenomena as they exist, without manipulation (Gravetter et al., 2021). An explanatory correlational design was utilised. This design was relevant because it allows one to observe the extent to which the chosen variables co-vary (Howell, 2017). The independent variables in the current study were interpersonal relation orientation in its totality (total score or SII Index) as well as the three traits (inclusion, control and openness) respectively, while resilience was the dependent variable. The hypothesized moderator between the variables was locus of control (both internal and external).

3.4 Sampling method and participants

Non-probability, convenience sampling was used because the target population is easily accessible and in the domain of contact of the researcher however not representative of the target population (Stangor, 2015). The target population was specific to pilots actively involved in training and/or those still actively flying.

Inclusion criteria for participants encompassed the following: they had to be 18 years and older, have a valid pilot's licence and an English language proficiency certificate, acceptable to operate in the aviation industry. The sample included pilots at different levels in their careers and/or general aviators with various amounts of flight hours and experience to ensure maximum participation inclusion and to be able to consider the effect of age and flight experience on the research question. Male and female, as well as pilots of different races have been included. Retired or aspiring pilots were excluded from the sample.

Participation was voluntary and to maintain impartiality, no incentives were given to participating individuals (Etikan et al., 2016). Initially, accessibility was challenging due to the decentralized aviation community. Sampling was therefore extended to spread over different clusters and areas (e.g. flight schools in different locations).

A total of 131 participants were included in the final group of participants. The study sample of 131 participants included 16% female and 84% male participants consisting of pilots ranging from 25-60 years in age (Mean = 34.7, SD = 9.6) with a range of total pilot accumulated flight hours from 0-23 000 and any level of training between a Student Pilot's Licence (SPL) and an Airline Transport Licence (ATPL). Table 1 (p. 45) outlines the distribution of the sample in terms of gender, age, level of training, ethnicity, flight hours and years in aviation.

From Table 1 it is evident that the majority of respondents were male (84.0%) and Caucasian (96.1%). Most of the participants (82.5%) were between 25-45 years of age and only 15.3% of the total sample had more than 5000 flight hours. The majority (51.5%) have a Commercial Pilot Licence (CPL) while 61.8% had 10 or less years' experience in aviation.

Table 1

Frequency distribution according to gender, age, level of training, ethnicity, flight hours and years in aviation

Biographical variable	N	%
Gender:		
Female	21	16.0
Male	110	84.0
Ethnicity:		
Caucasian	120	91.6
Coloured	3	2.3
Black	3	2.3
Asian	2	1.5
Other	3	2.3
Age		
25-35	85	64.9
36-45	23	17.6
46-55	18	13.7
56-60	5	3.8
Level of training		
Student Pilots Licence	5	3.8
Private Pilots Licence	24	18.5
Commercial Pilots Licence	67	51.5
Airline Transport Pilots Licence	34	26.2
Flight hours		
0-200	23	17.6
201-1000	37	28.2
1001-5000	51	38.9
5001-10000	12	9.2
>10000	8	6.1
Years in aviation		
0-5	34	26.6
6-10	45	35.2
11-15	14	10.9
16-20	14	10.9
>20	21	16.4

3.5 Data collection procedures and measuring instruments

Surveys were used and various flight institutions were contacted. The researcher made use of different opportunities within these institutions, where aviators were gathered (e.g. safety meetings), to administer the questionnaires. Where physical contact could not be established, research packs were directly distributed to flight schools, non-scheduled operators and scheduled operators.

In addition online sampling methods had to be employed and over a period of approximately two years an anonymous online survey link was also emailed and posted to aviation forums on Facebook for potential participants. Participants were also asked to distribute the link to known aviators within the inclusion criteria. Therefore, convenience sampling was initially implemented, where after snowball sampling (Parker et al., 2020) was relied upon to obtain sufficient respondents.

To gather data three separate questionnaires were put together as one research pack or electronic link with 4 sections. Most participants used the online link to complete the research questionnaires. A challenge with online surveys, however, is keeping participants engaged throughout the completion of the whole questionnaire (Balazadeh & Hansson, 2021). Nevertheless, the online nature of the data-collection instruments added to the convenience of the participants (Miner & Jayaratne, 2014). All participants were required to complete a biographical questionnaire to obtain descriptive data on the compilation of the sample as tabled in section 3.4 together with the three questionnaires used to operationalize the research variables.

The online data gathering link included four sections: the biographical questionnaire, followed by the three questionnaires — FIRO-B, Aviation Safety Locus of Control (ASLOC) and the Inventory to assess Behaviour towards Organisational Resilience in Aviation (I-

BORA). The complete bulk online questionnaire consisted of 105 items and was estimated to take about 45 minutes to complete. All items were compulsory. By choosing to employ an online survey the researcher reduced any research leader effects and reactivity. It also increased the convenience of the survey as participants were able to complete the survey wherever and whenever they were available. During the global pandemic in 2020 and 2021 it also improved the safety of participation by avoiding any physical contact (Balazadeh & Hansson, 2021).

3.5.1 Fundamental Interpersonal Relations Orientation–Behavioural Scale (FIRO-B)

William Schutz developed the FIRO-B scale in 1958 in an effort to understand and measure behaviour in high performing military events that are associated with interpersonal relation needs (Hammer & Schnell, 2000; Schutz, 1978). The FIRO-B is based on the theoretical stance hypothesized by Schutz (1978), that individuals will strive to develop relationships that are corresponding with (Harms, 2017) and will fulfil their personal social needs (Furnham, 2008).

The FIRO-B is a self-report scale that indicates the level of comfort that is perceived with regard to interpersonal behaviour and provides good insight into dynamic interaction in team settings with special reference to the compatibility of interrelated units (Furnham, 2008). It consists of 54 questions answered on a Likert type scale (Hammer & Schnell, 2000).

The FIRO-B proposes that individuals have three interpersonal needs that are responsible for driving and therefore predicting behaviour: need for inclusion, need for control, and need for openness (previously known as affection). All three needs are depicted by the level of wanted and expressed behaviour (Harms, 2017). Firstly, Inclusion indicates the need to be included into social settings and is referred to as the need to maintain relationships. The need for control refers to the balance of influence within relationships, specifically, the control that is expressed or wanted by oneself. Lastly the need for openness or affection refers to the degree of intimacy or closeness required in personal relationships.

Individual answers on the items of the various domains of the FIRO-B yields a 2 X 3 matrix of scores indicating six need driven behaviour scores namely, expressed inclusion, wanted inclusion, expressed control, wanted control, and expressed openness and wanted openness. By adding the wanted and expressed score of a domain, a total need score per domain can be derived for everyone. An individual's interpersonal relations orientation is indicated by a Social Interaction Index (SII) that is derived by the combination of his/her three total domain scores (i.e., total inclusion, total control and total openness) (Schutz, 1958). These combined total need scores are the obtained scores used in the statistical analysis of this study. Higher scores indicate higher needs with regard to the domain involved or regarding the total social interaction index (SII) which specifically indicates the need for social interaction.

Hammer and Schnell (2000) found that the internal consistency ranges from 0.85 to 0.96 and test-retest reliability coefficients ranged from 0.71 to 0.85. The construct validity of the instrument is supported by various correlational studies (Hammer & Schnell, 2000).

3.5.2 Aviation Safety Locus of Control Scale (ASLOC)

This is a self-scoring scale developed by David R. Hunter (2002), adapted from Jones and Wuebker's (1985) Safety LOC Scale. It pertains to aviation situation specific behaviour which specifically addresses the construct of internal versus external locus of control among pilots. Items are worded in a manner that relates to issues relevant to the aviation context. The scale consists of 20 items (10 items representing each unique factor) answered on a 5-point Likert scale ranging from Strongly Agree (1) to Strongly Disagree (5). There are two approaches to scoring and interpreting the scale: either as a single continuum trait or two separate, distinct constructs. During scoring items indicating external LOC will be left in the original response orientation while items indicating internal LOC will be reversed scored. This allows scores to range from 20 (most external) to 100 (most internal) (Hunter, 2002) in the one-dimensional approach. In obtaining scores for two separate constructs each subscale will obtain a score between 10 (minimum) and 50 (maximum) indicating low versus high internal (I) locus of control or low versus high external (E) locus of control respectively.

The coefficient Alpha of the combined scale score of the Aviation Safety Locus of Control Scale (ASLOC) was found to be 0.75. For the separate Internality and Externality scoring version both subscales exhibited satisfactory internal consistency respectively, namely 0.69 for internal (I) and 0.63 for external (E) locus of control. The correlation between internal and external subscales of the separate scale scoring version was found to be -0.419 (n =447, p <0.001) (Hunter, 2002). A study conducted by Nuhu found the overall reliability to be 0.70 whilst that of the two separate subscales were slightly higher than what Hunter reported: = .72 (vs. .69) for internal LOC, and = .76 (vs. .63) for external LOC (Nuhu, 2019). The theoretical position of this study and the literature leans more favourably towards the separate internal and external, thus multidimensional approach and scoring (see Hunter, 2002, p3). The construct validity for both the approaches to scoring the ASLOC was measured by Hunter and found supported by using the Hazardous Attitudes Inventory and Hazardous Events Scale.

3.5.3 Inventory to assess Behaviour towards Organisational Resilience in Aviation (I-BORA)

The I-BORA is a self-reporting scale developed by Michaela Heese, Wolfgang Kallus and Christa Kolodej (2013), that consists of 20 statements on the topic of behaviour towards organisational resilience. It is answered on a 7-point frequency scale ranging from never (0) to always (6). Zero indicates no level of resilience capacity and six indicate complete resilience and vice versa for the reverse scored questions. The I-BORA measures derived behaviours towards organisational resilience that can be observed on the job (Heese et al., 2013). The scale can be adapted to suit the requirements of the context of a study or the specific population of interest.

The I-BORA has four components namely goal directed/proactive solutions, flexibility, improvisation and availability of resources and was validated in the context of the HRO environment of aviation. The Cronbach's Alpha of the four components was found to be: goal directed/proactive solutions =.787, flexibility = .633, improvisation = .671, availability of resources = .708 (Heese et al., 2013).

3.6 Statistical procedures

Since the research entailed quantitative methods of data gathering the Statistical Package of the Social Sciences (SPSS) version 27 (IBM Corporation, 2017) was employed to analyse the quantitative results of the study. The reliability coefficients of all employed questionnaires were investigated at which time the descriptive statistics (skewness, kurtosis, means, standard deviations and correlations) were calculated. In order to determine whether significant correlations between interpersonal relations orientation and resilience, as well as between locus of control and resilience exist, Pearson correlations have been calculated. Moderated hierarchical multiple regression analyses (Howell, 2017) have been performed to investigate the moderator role of locus of control in the relationship between interpersonal relations orientation and resilience amongst aviators.

A moderator only shows an effect when a difference exists between the strength of the correlation coefficients of two groups and/or when there may be a difference between the direction in which the relations would be present. To investigate the moderating effect of a variable, the product between the independent and intervening variable has to be calculated. When working with the product of two variables, it is important to prevent multicollinearity (Howell, 2017). Therefore, deviation scores of the involved variables (observed score minus the mean) were calculated; after which the product between these two sets of deviation scores were calculated. To investigate the moderating effect of Locus of Control, the model of Baron and Kenny (Howell, 2017) was used. Both the 1% and 5% level of significance is used. To determine a significant *interaction effect*, a lessened *p*-value of 0.1 was applied (Aiken et al., 1991).

Derived from Hunter (2002), it may also be necessary to investigate the possible moderating effect of age and flight hours in the relationship between interpersonal relations orientation and resilience. If any of these two variables could be identified as possible moderators, the procedure to proceed with the analyses should then be changed.

3.7 Ethical considerations

Due to the competitive nature and high level of scrutiny involved in crew review, participants could have feared for future infringement in a study that focuses on personal constructs. Therefore it was of utmost importance to adhere to ethical standards. The ethical standards for academic research, as informed by the SA Board of Psychology, have been applied (Allan, 2015). Ethical clearance was obtained from the Research Ethics Committee of the Faculty of Humanities of the University of the Free State (UFS-HSD2018/0551) and permission was obtained from the relevant flight authorities at the flight institutions before the research commenced. All research participants were given the opportunity to make an informed decision about participation, the voluntary nature thereof, the purpose and reasons for the research (Stangor, 2015). Anonymity and confidentiality of the participants has been protected by not releasing any personal information in the proposed research findings that will enable any reader to identify a participant or put their current careers at risk (Allan, 2015). No employers had access to the personal answers and data gathered from participants and their answers did not affect their occupation or employment.

The online link provided respondents with the ability to complete the questionnaire at their own convenience and the option to cancel the questionnaire at any time during the four sections, without the information being submitted. In order to guarantee confidentiality during this process, data was only handled by the author and supervisors of this study.

3.9 Summary

This chapter outlined how the research was conducted, covering the following aspects: the research problem and objectives; research design of the current study; the research participants; sampling; the data-gathering procedure; the measuring instruments used; statistical procedures and the ethical considerations that are relevant to the study.

The study aimed to investigate the dynamics of human interaction and human needs of aviators in the HRO. In an industry that is ultra-safe, a deeper understanding of the dynamics of human interpersonal relations, specifically in a cockpit environment (HRO), may further enhance safety. The independent variables included the Interpersonal Relation Orientation in its totality (total score) as well as the total scores of the three traits (inclusion, control and openness) respectively, while resilience was the dependent variable. The hypothesized moderator between the variables was Locus of Control (internal and external). The next chapter details the analysis process and describes the findings of the research.

CHAPTER FOUR

RESULTS

4.1 Introduction

A discussion on the results of the statistical analyses is reported in this chapter. Firstly, the results of the descriptive analysis will be reported and discussed, followed by the results of the correlation coefficients between the relevant variables. Only correlations with medium to large effect sizes will be discussed. For correlations, Steyn (2020) reported that an effect size of 0.1 is small, an effect size of 0.3 is medium and an effect size of 0.5 is large. Pertaining to the moderated hierarchical multiple regression analysis, the results will only be discussed in cases where a statistically significant moderator effect is identified. Both the 1%- and 5%-level of significance were used in the analyses of the data.

4.2 Results

4.2.1 Means, standard deviations, skewness, kurtosis and reliabilities of the scores of the measuring instruments

The means, standard deviations, skewness, kurtosis as well as the internal consistencies (reliabilities) of the various scores of the measuring instruments are illustrated in Table 2 for the total group of aviators. Cronbach's alpha coefficient (α) was calculated as an indication of the internal consistency of the subscales.

Table 2

Descriptive statistics and reliability coefficients for the FIRO-B, I-BORA and ASLOC

Measures	N	M	SD	α	Skewness	Kurtosis
FIRO-B						
Inclusion	131	7.24	4.75	0.926	0.106	-1.379
Control	131	7.19	4.06	0.869	0.087	-0.920
Openness	131	6.83	3.88	0.728	0.563	-0.247
Total score	131	42.33	18.52	0.918	0.116	-0.772
I-BORA	131	76.24	10.96	0.820	0.174	-0.337
ASLOC						
Internal Locus	131	37.42	5.31	0.772	-0.222	-0.135
External Locus	131	33.32	4.75	0.657*	-0.635	1.714

Note: * item 18 omitted

From Table 2 it is evident that the Cronbach's α coefficients for the respective scores of the measuring instruments range from 0.657 to 0.918. These scales therefore display acceptable to high levels of internal consistency (Vogt, 2005) and were all included in the subsequent analyses. To improve the reliability of the external locus of control score, item 18 ("It is more important to complete a flight than to follow a safety precaution that costs more time".) was omitted. With item 18 included in the total external locus of control score the reliability coefficient was only 0.451. The distribution of scores was also investigated by calculating the skewness and kurtosis values of the different scores. According to Kahane (2008) the cut-off point for skewness is > | 2 | and kurtosis > |4|. From Table 2, it is evident that the scores on all the variables are within these cut-off points and thus do not deviate substantially from normality. It was then decided to include all of these scores in the analyses that will follow.

4.2.2 Correlation coefficients

The Pearson Product Moment correlation coefficients were calculated for the different scores and are illustrated in Table 3.

Table 3

Correlation coefficients between the FIRO-B, I-BORA and ASLOC scores

Variable	RES	INC	CNT	OPN	FIRT	LCI	LCE
Resilience (RES)	-	0.11	0.05	0.06	0.11	-0.02	0.13
Inclusion (INC)		-	0.25*	0.54*	0.84*	-0.04	-0.12
Control (CNT)			-	0.01	0.59*	-0.04	0.02
Openness (OPN)				-	0.66*	0.13	-0.09
Firo-Total (FIRT)					-	0.01	-0.07
Locus Internal (LCI)						-	0.15
Locus External (LCE)							-

* $p \leq 0.01$

From Table 3 it seems that none of the FIRO-B subscales or the FIRO-B total (Social Interaction Index - SII) show a statistically significant relationship, on the 5% level of significance, with the theorized dependent variable, resilience. However, even though the correlation coefficients are not statistically significant, all of them show a positive relationship with the resilience of aviators. From Table 3 it also seems that external locus of control show a positive correlation with the degree of resilience that aviators experience, even though it is not statistically significant. According to Hayes (2017) if no statistical significant relationship exists between the independent and dependent variables, it is still important to determine the possible role of an intervening variable in the relationship between these variables. Consequently, the role of internal and external locus of control in the relationship between interpersonal relation behaviour and resilience of aviators was investigated.

In the paragraphs that follow, the moderated hierarchical multiple regression analyses that were conducted to determine the possible moderating effect of the locus of control (internal as well as external) on the relationship between interpersonal relations orientation and resilience of aviators are described and reported. In order to conduct the analysis, the data was checked to ensure that all assumptions of multiple regression analyses were met. Normality, linearity, multicollinearity and homoscedasticity were investigated. Outliers were investigated through calculating Mahalanobis distance. The critical value of chi-square, for one dependent variable, at an alpha level of .001 is 10.828. The dependent variable (resilience) did not violate the distance. All the other assumptions for regression analyses were met. However, before the research hypothesis was investigated, the possible role that flight hours and the age of aviators in the relationship may have was investigated and will be discussed in the following paragraph.

4.2.3 Role of age and flight hours

The literature reports that resilience and interpersonal relation orientation may vary according to age and flight hours as individual variables (Baugh, 2020; Douglas & Pittenger, 2020; Hunter 2002). Therefore it was deemed important to investigate the possible effects on interpersonal relations orientation and the resilience of aviators. These two demographic variables were investigated applying the moderated hierarchical multiple regression analyses. The results in Table 4 show the possible effect of flight hours (Model 2a) and age (Model 2b) respectively. If it is found that they do play a role, all subsequent analyses should then be conducted separately.

As each of the independent variables was analysed separately, these variables are presented in the first column of Table 4.

Table 4

Moderating effect of flight hours and age of aviators in the relationships between Interpersonal Relations Orientation and Resilience

				Change statistics					
Independent variable	Model	*R*	*R*²	Adjusted R²	*R*² change	*F* change	df1	df2	Sig F change
Inclusion	1	.111	.012	.005	.012	1.597	1	128	.209
	2a	.138	.019	.003	.007	0.853	1	127	.357
	1	.111	.012	.005	.012	1.597	1	128	.209
	2b	.111	.012	-.003	.000	.008	1	127	.928
Control	1	.051	.003	-.005	.003	.329	1	128	.568
	2a	.086	.007	-.008	.005	.623	1	127	.431
	1	.051	.003	-.005	.003	.329	1	128	.568
	2b	.088	.008	-.008	.005	.673	1	127	.413
Openness	1	.055	.003	-.005	.003	.392	1	128	.532
	2a	.126	.016	.000	.013	1.649	1	127	.201
	1	.055	.003	-.005	.003	.392	1	128	.532
	2b	.055	.003	-.013	.000	.001	1	127	.979
Total score	1	.113	.013	.005	.013	1.659	1	128	.200
	2a	.113	.013	-.003	.000	.000	1	127	.992
	1	.113	.013	.005	.013	1.659	1	128	.200
	2b	.113	.013	-.003	.000	.000	1	127	.995

Since no significant increase in R^2 with the addition of either flight hours or age to the regression Model 1 (in which each of the interpersonal relations orientation subscales – inclusion, control, openness and total score - solely formed part of the equation) occurs, it can be concluded that neither age nor flight hours could be identified to be a moderator in the abovementioned relationships for the aviators who participated in this study.

The following section presents the results of the moderated hierarchical multiple regression analyses that were conducted to investigate the research hypothesis, namely does LOC moderate the relationship between interpersonal relation behaviour and resilience.

4.2.4 Locus of control as moderator

The results in Table 5 (p. 60) show the possible moderator effect of external locus of control in the relationship between interpersonal relations orientation and resilience amongst aviators.

The results in Table 5 show that there is no interactional effect (model 2a) for any of the independent variables. Therefore it can be accepted that external LOC does not moderate the relationship between these independent variables and resilience of aviators. Consequently, the possible moderator effect of internal LOC was investigated. These results are shown in Table 6 (p.61).

Table 6 shows that the interaction effect between the total FIRO-score and internal locus of control (model 2a) shows a statistically significant interaction effect that was found on the 10% level [$\Delta R^2 = .027$, $F_{1;\,127} = 3.617$; $p = .059$]. It can therefore be concluded that internal locus of control indeed moderates the relationship between interpersonal relations orientation and resilience of aviators.

Table 5

Moderating effect of External Locus of Control in the relationships between Interpersonal Relations Orientation and Resilience

				Change statistics					
Independent variable	Model	*R*	*R*²	Adjusted R²	*R*² change	*F* change	df1	df2	Sig F change
Inclusion	1	.111	.012	.005	.012	1.597	1	128	.209
	2a	.119	.014	-.001	.002	0.239	1	127	.626
Control	1	.051	.003	-.005	.003	.329	1	128	.568
	2a	.119	.014	-.001	.012	1.499	1	127	.223
Openness	1	.055	.003	-.005	.003	.392	1	128	.532
	2a	.132	.017	.002	.014	1.853	1	127	.176
Total score	1	.113	.013	.005	.013	1.659	1	128	.200
	2a	.113	.013	-.003	.000	.000	1	127	.992

Table 6

Moderating effect of Internal Locus of Control in the relationships between Interpersonal Relations Orientation and Resilience

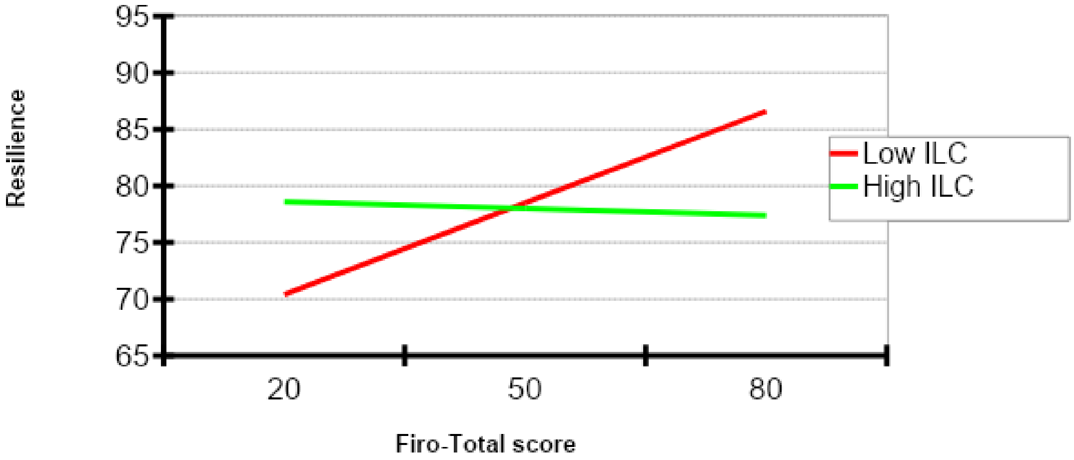
				Change statistics					
Independent variable	Model	R	R^2	Adjusted R^2	R^2 change	F change	df1	df2	Sig F change
Inclusion	1	.111	.012	.005	.012	1.597	1	128	.209
	2a	.166	.028	.012	.015	1.993	1	127	.160
Control	1	.051	.003	-.005	.003	.329	1	128	.568
	2a	.098	.010	-.006	.007	.893	1	127	.347
Openness	1	.055	.003	-.005	.003	.392	1	128	.532
	2a	.095	.009	-.006	.006	.776	1	127	.380
Total score	1	.113	.013	.005	.013	1.659	1	128	.200
	2a	.200	.040	.025	.027	3.617*	1	127	.059

$p \leq 0.10$

The nature of this moderator effect was investigated by calculating the relationship between interpersonal relation orientation and the criterion (resilience) for participants who scored low and high respectively on the moderator effect (internal LOC). Two separate regression lines where calculated - one for participants who scored high on internal LOC (on or higher than the 75th percentile, N = 29; a score of 41 and higher) and one for participants who scored low on internal LOC (on or lower than the 25th percentile, N = 30; a score of 31 or lower). The regression lines are shown in Figure 1.

Figure 1

Regression lines of aviators with respective low and high levels of internal locus of control with interpersonal relation orientation (total score on the FIRO-B) as predictor of resilience



From figure 1 it is evident that a sharp increase in the regression line occurs for participants with a low internal LOC score. For the group with a high internal LOC score, a moderate decrease in slope occurs. For the second group, no statistical significant correlation (r = -0.037; p = .850) came about between interpersonal relation orientation and resilience. However, for the group with low internal LOC a statistically positive correlation on the 5% level (r = 0.41; p = .037) occurred between interpersonal relation orientation and resilience.

Last mentioned correlation coefficient shows, according to Cohen (1988), a medium effect size. It can be accepted that the results in this case are of practical interest.

The research question of this study, namely to determine whether the relation between interpersonal relation behaviour and resilience is moderated by a pilot's locus of control, was therefore answered affirmatively. More specifically, the results provided evidence that aviators with low levels of internal LOC experience a significant increase in resilience with an increase in interpersonal relation orientation behaviour. Whilst this is not the case for aviators with a high level of internal LOC.

The results presented in this chapter will be discussed within the context of the research hypothesis and the literature in the next chapter.

CHAPTER FIVE

DISCUSSION, LIMITATIONS, RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

The following chapter serves as the encompassment of the research conducted and the way forward. In a field of research that is already ultra-safe and well researched, it is of significant importance to find but a single factor that can contribute to the understanding and the enhancement of safety.

The researcher aimed to find a baseline understanding of the influence of locus of control on the relationship between interpersonal relation orientation and resilience. More specifically, the objective was to identify whether there is a significant relationship between resilience and fundamental interpersonal orientation and secondly to determine if the behaviour that results from this orientation is moderated by a pilot's locus of control. The literature review and arguments presented in Chapter 2 reinforces and clarifies that the aviators, as part of a HRO, serves as a core factor in proactive accident prevention. Therefore, even the slightest better understanding of humans in a HRO can contribute to preventing the loss of life and hull. In the literature research worthy notions of all variables of interest to this study were found but no study was found that brings all these variables together. Also, no study was found to have been conducted within the South African aviation context.

5.2 Discussion of findings

None of the FIRO-B subscales, nor the FIRO-B total (Social Interaction Index – SII) showed a statistically significant relationship with the dependent variable, resilience. However, even though the correlation coefficients were not statistically significant, all of them showed a positive relationship with the resilience of aviators. Although the findings were not significant, the literature suggests that a plausible significance exists as interpersonal relation orientation not only protects resilience but also serves as a resource for resilience (Masten, 2019; Theron 2020) and should be considered for future research with new design parameters or measurements.

The results of the study partly confirm the moderating effect of LOC on the relationship between interpersonal relation orientation and resilience. The findings indicated that E-LOC does not have a moderating effect on the relationship between interpersonal relation orientation and resilience, expanding on previous work of Türk-Kurtça and Kocatürk (2020), who described the negative effect of E-LOC on resilience. This can be the result of individuals who are high in external behavioural motivation being unable or being reluctant to strive for compatibility and relational equilibrium. They might believe that interpersonal factors are outside of their control and will therefore possibly suppress the mobilization of resources to be resilient (Harms, 2017).

The results were in accordance with findings of Rizkia and Kusristanti (2020), who stated that internal LOC is known to contribute to resilient individuals through enhanced self-control and problem-solving. Other studies (Edwards et al., 2016; Georgescu et al., 2019) also established associations between I-LOC and resilience. Based on these findings, the researcher focused more in depth on the moderating effect of I-LOC on the relationship between interpersonal relation orientation and resilience.

However, data-analysis revealed a surprising result where individuals with a high I-LOC showed no statistically significant correlation between interpersonal relation orientation and resilience. It was found that participants with a high I-LOC showed a lower resilience score as their interpersonal relation orientation increased. A possible explanation for this finding may be that a high level of I-LOC focusses the individual on personal control from within, which may lead to the inability to embrace or understand those in his/her immediate contact (crew members) and environment (HRO) (Hunter & Stewart, 2012). This can lead to a failure in pursuing equilibrium in interpersonal relation interaction which may cause all present to be less resilient. In the presence of adversity within the HRO, it is critical to activate the joint ability within the cockpit in a united effort. To do so, the presence of high interpersonal relation orientation behaviour is necessary, which will lead to resilience in the team and not in a personal capacity (Joseph & Ganesh, 2006). Thus, the results indicate that it is possible that interpersonal relation orientation may be the key factor to the presence of resilience in a person and in a team, creating a resilient living system. Individuals with high I-LOC will consequently not regress to the entity of the team but rather to themselves, thereby negatively influencing cohesion in a team setting, reinforcing the literature on this topic (Balazadeh & Hansson, 2021).

On the other hand, the deeper analysis of internal LOC affirmed the literature by concluding that a low I-LOC statistically significantly moderates the relationship between interpersonal relation orientation and resilience of aviators in a positive way. The results of this study found that aviators with a low I-LOC have an increase in resilience directly proportionally related to an increase in their overall interpersonal relation orientation affirming the results found by Edwards et al., (2016) that I-LOC was an independent predictor of resilience. A possible explanation may be that aviators with low I-LOC are more adaptive in their relational orientation (Hunter & Stewart, 2009). Also, individuals with low I-LOC may tend to be more willing to participate in discourse for solutions in the hope to find psychological safety and therefore they tend to find higher perceived value in interaction.

As indicated in the related literature (Nykänen, 2020), resilience can thus be high in individuals with a high I-LOC, or it can be high in the presence of an increased interpersonal relation orientation that serves as a source for resilience in the presence of a low I-LOC as in this study. The latter protects team cohesion, which may improve the experience of safety in a team setting and which will unify the team as one entity or living system. Even though Nykänen (2020) stated that high I-LOC individuals are described to usually have a high psychological resilience, this study found that interpersonal relation orientation does not serve as a source for resilience in these high I-LOC aviators with a subsequent loss in a crew setting cohesion. It may be that interpersonal relation orientation and resilience within the team is more valuable than high I-LOC as a singular factor since the individual with high I-LOC then regresses to self-preservation.

Although the literature indicated the possible effect of age (Hunter & Stewart, 2012) and flight hours (Douglas & Pittenger, 2020), the possible effect of these two demographic nuisance or intervening (Gravetter et al., 2021) variables were investigated by applying the moderated hierarchical multiple regression analyses. However, there was a lack of evidence as neither age nor flight hours could be identified to be a moderator in the mentioned relationships for the aviators who participated in this study.

It is worth noting that the current findings may be unique to South Africa due to its dynamic portfolio of aviators. Implications of diversity may have to be considered with interpretation of results, although in the current study only 8.4% of participants were represented by ethnic cultures other than Caucasian. However, no other research was found in the South African context to support the measurements used or the findings of this study.

5.3 Limitations of the study

The current study aimed to increase and contribute to the understanding of psychosocial limitations within the HRO in order to possibly predict human behaviour. Extensive literature exists regarding all variables within this study, although minimal data relates directly to the HRO context or the interaction of variables chosen by the researcher for this study. This enabled the researcher to feasibly contribute to the overall body of knowledge of aviation safety by focussing on the moderating effect of locus of control on the relationship between interpersonal relation behaviour and resilience. However, it remains imperative to interpret the results of this study within the context of the limitations of this study.

The first limitation of the study relates to the mental health of the participants within the framework of the global pandemic in 2020 during which much of the data was gathered. Due to Covid 19-regulations, a large setback within the aviation industry was observed. With the collapse of the student market and the psychosocial effects of the pandemic, a decrease in pilots' mental health was noted (Vuorio & Bor, 2020). This proved challenging in gaining access to participants for the study and also impacted aviators' willingness to complete a 45-minute questionnaire.

The current sample consisted of 91.6% Caucasian participants, who were mostly males (84.0% male and 16.0% female). Taking into account that the demographic of the sample is not representative of the aviation population, together with the fact that convenience and snowball sampling were used, a clear limitation regarding the generalization of the findings exists.

All measures used within the study were self-report measures. Such measures are often open to deliberate misrepresentation or manipulation (Howell, 2017). Because of the extreme competitive nature that aviation brings about, it is possible that participants wanted to answer in a socially desirable way in order to portray more “pilot-like” behaviour. This could have been influenced further by pilots’ misconception that psychometric evaluations can result in the loss of a medical clearance certificate to fly. The ‘fear’ for psychometrics could have influenced the way in which self-report measures were answered. However, despite these limitations, the study presents a meaningful contribution to the literature but also shows the need for deeper analysis.

5.4 Recommendations for future research

For future research, it might be valuable to use a more heterogeneous sampling group in a higher quantity with regards to certain demographic factors in order to gain more generalizable results. It would also be valuable to use different scales in order to verify the current findings. Since the complexity of resilience and interpersonal dynamics are quite extensive and difficult to define, it can be recommended that more defined parameters are set to be researched - the contextual dynamics of team resilience versus individual resilience.

Further investigation into I-LOC will also prove valuable in order to gain a deeper understanding into the correlation between LOC, interpersonal behaviour and resilience with specific insights into the role of LOC in this relationship. More research is needed on the developmental dynamics of I-LOC, especially in professions such as aviation.

In the present study no statistically significant relation was found between the subscales of the FIRO-B and the dependent variable, resilience. Further investigation into the pattern of the six matrix fields that eventually determine the FIRO-B total or Social Interaction Index (SII) may possibly provide information on how interpersonal orientation relation behaviour actually influences resilience.

Using mixed methods can also be considered - combining quantitative data with qualitative aspects such as debriefs and observed behaviour in and after simulated flights to directly assess safety behaviour and/or accident involvement. Further replication studies are also needed in which to conduct similar model comparisons.

5.5 Conclusion

The primary aim of this study was to explore the moderating effect of LOC on interpersonal relation orientation behaviour and resilience. The results of this study showed that a low internal locus of control does statistically significantly moderate the relationship between interpersonal relation orientation behaviour and resilience positively.

The researcher has operationalized these constructs using the FIRO-B, ASLOC and I-BORA Questionnaires. As discussed in the section on results the moderation effect of both internal and external LOC was investigated. The latter (E-LOC) has no statistical significant moderating effect on the relation between interpersonal relation orientation and resilience.

The argument made in the literature review of the current study has shown that it is essential to allow openness and inclusion with a moderated I-LOC in order to be resilient. A positive effect of interpersonal relation orientation as postulated in the literature review, that sources resilience in the absence of a high ILOC, may be the key to team cohesion and an inclusive thinking living system in the HRO environment. However, the research findings in this study only brings new knowledge regarding the source of resilience, now seen to be present in individuals with a lower I-LOC that positively moderates interpersonal relation orientation that harbours resilience. The team cohesion allowed by the combination of interpersonal relation orientation and resilience as present with a lower I-LOC may increase safety motivation in an open and inclusive environment.

The results of this study point towards the importance of understanding how human behaviour in the HRO contributes to the enhancement of safety, and that deeper analysis into the motivation of human behaviour can be a proximal antecedent of safety behaviour.

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Appendix A: Ethical clearance and extension

Faculty of the Humanites

21-Nov-2018

Dear **Mr Kotzé**

Ethics Clearance: **Locus of control as moderator in the relationship between interpersonal relation behaviour and resilience in the High Reliability Organisation (HRO) environment of aviators in training** Principal Investigator: **Mr Izak Kotzé**
Department: **Psychology Department (Bloemfontein Campus)**

APPLICATION APPROVED

With reference to your application for ethical clearance with the Faculty of the Humanities. I am pleased to inform you on behalf of the Research Ethics Committee of the faculty that you have been granted ethical clearance for your research.

Your ethical clearance number, to be used in all correspondence is: **UFS-HSD2018/0551**

This ethical clearance number is valid for research conducted from 21-Nov-2018 to 21-Nov-2019. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the ethics office to ensure we are kept up to date with your progress and any ethical implications that may arise.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research. Yours Sincerely

Dr. Asta Rau

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Chair: Research Ethics Committee
Faculty of the Humanities

1 December 2019

Ms Charné Vercueil
Ethics Committee: Faculty of the Humanities
University of the Free State

Dear Ms Vercueil
vercueilcc@ufs.ac.za

Ethical Clearance extension request:

I would like to request that the ethical clearance I received in November 2019 for my master's studies project: ***Locus of control as moderator in the relationship between interpersonal relation behaviour and resilience in the High Reliability Organisation (HRO) environment of aviators in training*** to be extended for another year. I am halfway with my data collection and am experiencing difficulties in obtaining enough participants.

My ethical clearance number is: UFS-HSD2018/0551
My student number is: 2006023408

Yours sincerely,

Mr I Kotzé
Student number: 2006023408
Student/Researcher
itkotze@gmail.com

MvanDijk

Ms M van Dijk
Supervisor
(vandijkm@ufs.ac.za)
X2596
Prof Karel Esterhuyse
Co-supervisor
esterkg@ufs.ac.za

LFC

LANSERIA FLIGHT CENTRE (Pty) Ltd
Reg. No.2002/018484/07

Terminal Building, Grand Central Airport. P O Box 51, Lanseria, 1748, South Africa
Tel: +27 11 312 5166 Fax: +27 11 312 5159. Website www.flylfc.com Email
info@flylfc.com

Appendix B: Permission from relevant flight authorities and flight institutions

To whom it may concern
*22/05/*2018

Hereby, please regard the following as approval from Lanseria Flight Centre to allow Mr Izak Theo Kotzé (8909185179086), under the helm of the University of the Free State, the use of our training organisation as a platform for data acquisition and an area of sampling. Please note that Lanseria Flight Centre accepts no responsibility for the ethical and procedural standards in this study and will under no circumstances force any student to partake in the proposed study. Lanseria Flight Centre has by no means any relation to the outcome and data of this study, other than allowing contact with the student to Mr Kotze and an area of interaction. Lanseria Flight Centre acknowledges that the study is an independent endeavour and that the company can by no means be held liable as well as claim rights to the research, Lanseria Flight that the research study will be conducted under the supervision of *M*e M. van Djik (Van Dijkm@ufs.ac.za) and co-supervision of Prof K. Esterhuysen (esterkg@ufs.ac.za Head of the Department of Psychoiogy under the Faculty of Humanities.

I bid you the best in the advancement of aviation safety research and in the process of research.

Kind Regards,

Ian Dyson
Director

Appendix C: Research pack (Biographical information, FIRO-B, ASLOC, I-BORA)

Biographical Questionnaire

PLEASE MAKE SURE TO FILL IN ALL AREAS IN ALL OF THE MENTIONED QUESTIONNAIRES.

1. Name and Surname (voluntary) ____

2. Age: ____

3. Gender: ____

4. Race: ____

5. Approximate total time: ____

6. Years involved in Aviation (Valid SPL/PPL/CPL) __________________________________

7. Fixed Wing/Helicopter Pilot:

Fixed Wing
Helicopter

8. Flight Qualifications:

PPL
CPL
ATPL
Night Rated
Instructor Rated
Gr I
Gr II
Gr III
IF
Twin Rated
Multi-Crew
Training Captain

9. Career Perspectives:

Recreation
Career
Part-time

10. Past Experience and Approximate Hours: (mark relevant experience and fill in approximate hours)

Experience:	**Approximate hours:**
Charter	
Bush Flying	
Corporate	
Instruction	
Experience:	**Approximate hours:**
Private	
Hour Building	
Military	

11. Would you recommend only 1 OR more than 1 instructor in the ab-initio phase of flight training?

Only 1

More than 1

12. Ranked in order, what attributes or behaviour do you deem most important for flight instructors to have?

1. ____
2. ____
3. ____O

nly PPL and CPL students:

13. Estimated, how many instructors have you had during the course of your training?

☐

Fundamental Interpersonal Relations Orientation-Behaviour (FIRO-B)

For each statement below, decide which of the following answers best applies to you.

For statements 1 - 16 use this rating scale:

1 Usually 3 Sometimes 5 Rarely

2 Often 4 Occasionally 6 Never

_____ 1.I try to be with people.

_____ 2.I let other people decide what to do.

_____ 3.I join social groups.

_____ 4.I try to have close relationships with people.

_____ 5.I tend to join social organizations when I have an opportunity.

_____ 6.I let other people strongly influence my actions.

_____ 7.I try to be included in informal social activities.

_____ 8.I try to have close, personal relationships with people.

_____ 9.I try to include other people in my plans.

_____ 10.I let other people control my actions

_____ 11.I try to have people around me.

_____ 12.I try to get close and personal with people.

_____ 13.When people are doing things together, I tend to join them.

_____ 14.I am easily led by people.

_____ 15.I try to avoid being alone.

_____ 16.I try to participate in group activities.

For statements 17 - 40 use this rating scale:

1 Most people 3 Some people 5 One or two people

2 Many people 4 A few people 6 Nobody

_____ 17.I try to be friendly to people.

_____ 18.I let other people decide what to do.

_____ 19.My personal relations with people are cool and distant.

_____ 20.I let other people take charge of things.

_____ 21.I try to have close relationships with people.

_____ 22.I let other people strongly influence my actions.

_____ 23.I try to get close and personal with people.

_____ 24.I let other people control my actions.

_____ 25.I act cool and distant with people.

_____ 26.I am easily led by people.

_____ 27.I try to have close, personal relationships with people.

_____ 28.I like people to invite me to things.

_____ 29.I like people to act close and personal with me.

_____ 30.I try to influence strongly other people's actions.

_____ 31.I like people to invite me to join in their activities.

_____ 32.I like people to act close toward me.

_____ 33.I try to take charge of things when I am with people.

_____ 34.I like people to include me in their activities.

_____ 35.I like people to act cool and distant toward me.

_____ 36.I try to have other people do things the way I want them done.

_____ 37.I like people to ask me to participate in their discussions.

_____ 38.I like people to act friendly toward me.

_____ 39.I like people to invite me to participate in their activities.

_____ 40.I like people to act distant toward me.

For statements 41 - 54 use this rating scale:

1 Usually 3 Sometimes 5 Rarely

2 Often 4 Occasionally 6 Never

_____ 41.I try to be the dominant person when I am with people.

_____ 42.I like people to invite me to things.

_____ 43.I like people to act close toward me.

_____ 44.I try to have other people do things I want done.

_____ 45.I like people to invite me to join their activities

_____ 46.I like people to act cool and distant toward me

_____ 47.I try to influence strongly other people's actions.

_____ 48.I like people to include me in their activities.

_____ 49.I like people to act close and personal with me.

_____ 50.I try to take charge of things when I'm with people.

_____ 51.I like people to invite me to participate in their activities.

____ 52.I like people to act distant toward me.

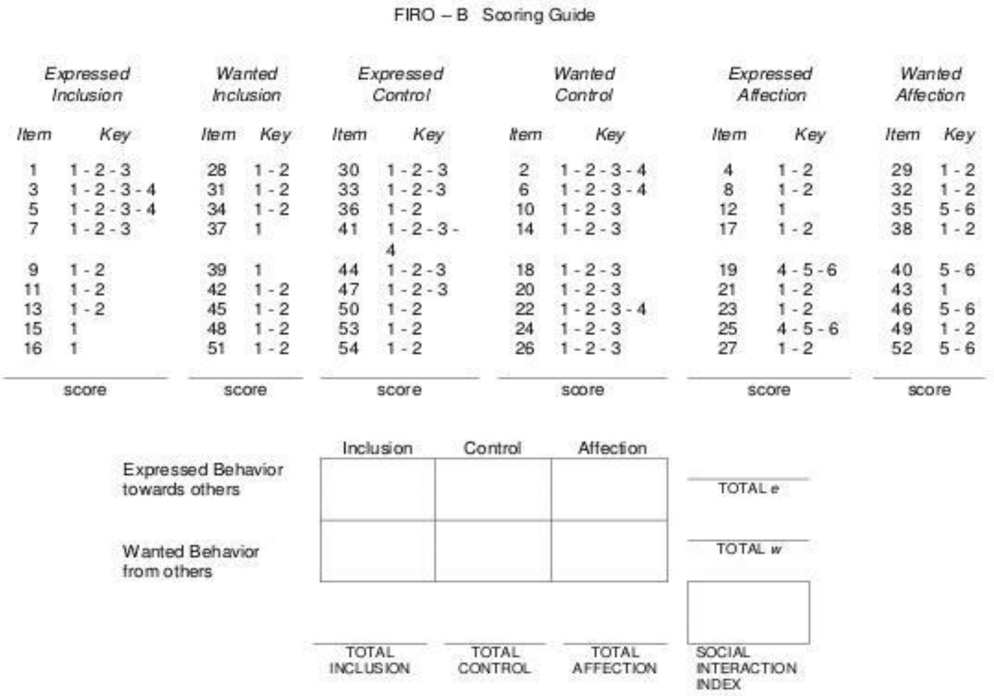
_____ 53.I try to have other people do things the way I want them done

_____ 54.I take charge of things when I'm with people.

Scoring Key

To derive your interpersonal orientation scores, refer to the table below. Note that there are six columns, each with items and keys. Each column refers to an interpersonal need listed in the chart at the bottom of the page. Items in the column refer to question numbers on the questionnaire; Keys refer to answers on each of those items. If you answered an item using any of the alternatives in the corresponding key column, circle the item number on this sheet.

When you have checked all of the items for a single column, count up the number of circled items and place that number in the corresponding box in the chart. These numbers will give you your strength of interpersonal need in each of the six areas. The highest possible score is 9. The lowest score is 0.



FIRO – B Scoring Guide

Expressed Inclusion		*Wanted Inclusion*		*Expressed Control*		*Wanted Control*		*Expressed Affection*		*Wanted Affection*	
Item	*Key*	*Item*	*Key*	*Item*	*Key*	*Item*	*Key*	*Item*	*Key*	*Item*	*Key*
1	1 - 2 - 3	28	1 - 2	30	1 - 2 - 3	2	1 - 2 - 3 - 4	4	1 - 2	29	1 - 2
3	1 - 2 - 3 - 4	31	1 - 2	33	1 - 2 - 3	6	1 - 2 - 3 - 4	8	1 - 2	32	1 - 2
5	1 - 2 - 3 - 4	34	1 - 2	36	1 - 2	10	1 - 2 - 3	12	1	35	5 - 6
7	1 - 2 - 3	37	1	41	1 - 2 - 3 - 4	14	1 - 2 - 3	17	1 - 2	38	1 - 2
9	1 - 2	39	1	44	1 - 2 - 3	18	1 - 2 - 3	19	4 - 5 - 6	40	5 - 6
11	1 - 2	42	1 - 2	47	1 - 2 - 3	20	1 - 2 - 3	21	1 - 2	43	1
13	1 - 2	45	1 - 2	50	1 - 2	22	1 - 2 - 3 - 4	23	1 - 2	46	5 - 6
15	1	48	1 - 2	53	1 - 2	24	1 - 2 - 3	25	4 - 5 - 6	49	1 - 2
16	1	51	1 - 2	54	1 - 2	26	1 - 2 - 3	27	1 - 2	52	5 - 6
score		score		score		score		score		score	

	Inclusion	Control	Affection	
Expressed Behavior towards others				TOTAL *e*
Wanted Behavior from others				TOTAL *w*
	TOTAL INCLUSION	TOTAL CONTROL	TOTAL AFFECTION	SOCIAL INTERACTION INDEX

Aviation Safety Locus of Control

For each statement there are five (5) possible answers ranging from Strongly Agree to Strongly Disagree. Please make your selection by marking the number corresponding to the appropriate answer.

For example:

Strongly Agree	[✓ Agree]	Unsure	Disagree	Strongly disagree	For office use

Please do not leave any statements blank.

Please turn to the next page and work through the questions sequentially in one go.

1. If pilots follow all the rules and regulations, they can avoid many aviation accidents.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

2. Accidents are usually caused by unsafe equipment and poor safety regulations.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

3. Pilots should lose their license if they periodically neglect to use safety devices (for example, seat belts, checklists, etc.) that are required by regulation.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

4. Accidents and injuries occur because pilots do not take enough interest in safety.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

5. Avoiding accidents is a matter of luck.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

6. Most accidents and incidents can be avoided if pilots use proper procedures.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

7. Most accidents and injuries cannot be avoided.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

8. Most accidents are due to pilot carelessness.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

9. Most pilots will be involved in accidents or incidents which result in aircraft damage or personal injury.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

10. Pilots should be fined if they have an accident or incident while "horsing around".

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

11. Most accidents that result in injuries are largely preventable.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

12. Pilots can do very little to avoid minor incidents while working.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

13. Whether people get injured or not is a matter of fate, chance, or luck.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

14. Pilots' accidents and injuries result from the mistakes they make.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

15. Most accidents can be blamed on poor FAA/CAA oversight.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

16. Most injuries are caused by accidental happenings outside people's control.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

17. People can avoid getting injured if they are careful and aware of potential dangers.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

18. It is more important to complete a flight than to follow a safety precaution that costs more time.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

19. There is a direct connection between how careful pilots are and the number of accidents they have.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

20. Most accidents are unavoidable.

Strongly Agree	Agree	Unsure	Disagree	Strongly disagree	

SAFETY CULTURE MATURITY QUESTIONNAIRE

I-BORA

Below you will find some questions regarding your behaviour in your current phase of training/flight.

For each statement there are seven possible answers. Please make your selection by marking the number corresponding to the appropriate answer.

For example:

In the current phase of training/flight…

… I enjoyed working in this company.

0	1	2	3	[✓ 4]	5	6
never	seldom	sometimes	often	more often	very often	always

In this example, the number 4 (= more often) is marked. This means that in the past 7 work days you more often enjoyed working in this company.

Please do not leave any statements blank.

If you are unsure which answer to choose, select the one that most closely applies to you.

Please turn to the next page and work through the questions sequentially in one go.

In the current phase of training/flight…

(1) … I was able to cope with an unexpected situation without the help of an instructor/ training captain.

0 never	1 seldom	2 sometimes	3 often	4 more often	5 very often	6 always

(2) … I was able to fill in for a colleague temporarily/assist a fellow student.

0 never	1 seldom	2 sometimes	3 often	4 more often	5 very often	6 always

(3) … I exchanged ideas regarding improvements with my colleagues/instructor/students.

0 never	1 seldom	2 sometimes	3 often	4 more often	5 very often	6 always

(4) … I tried to find alternative solutions for a problem.

0 never	1 seldom	2 sometimes	3 often	4 more often	5 very often	6 always

(5) … I considered a problem as a challenge.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(6) … I made decisions, although I was not 100% sure.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(7) … I actively avoided tasks/situations, because I felt overloaded.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(8) … I searched for solutions to a problem together with my colleagues/instructor/student.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(9) … I worked on improving myself in my job/training.

0 never	1 seldom	2 sometimes	3 often	4 more often	5 very often	6 always

(10) … I had sufficient knowledge to perform my tasks.

0 never	1 seldom	2 sometimes	3 often	4 more often	5 very often	6 always

(11) … I avoided any risk.

0 never	1 seldom	2 sometimes	3 often	4 more often	5 very often	6 always

In the current phase of training/flight…

(12) … I relied on my intuition when faced with a difficult situation.

0 never	1 seldom	2 sometimes	3 often	4 more often	5 very often	6 always

(13) … I achieved a good result by improvising.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(14) … I was sceptical in a new situation.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(15) … I knew who to attend to in case of problems.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(16) … I adopted my way of working to the situation.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(17) … I made use of informal contacts to solve a problem.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(18) … I actively avoided a situation that seemed chaotic to me.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(19) … I was not able to perform tasks as per procedure, because required resources were missing.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

(20) … I was missing certain information to cope with a difficult situation.

0	1	2	3	4	5	6
never	seldom	sometimes	often	more often	very often	always

Thank you for your participation!