The Influence of Confirmation Bias on the Decision Making of Emergency Services Pilots

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Abstract

Pilots of emergency services aircraft face complex, challenging, and life and death situations on a regular basis as part of their roles. The purpose of this research was to investigate how confirmation bias may influence pilots to make potentially unsafe decisions. Confirmation bias has previously been found to adversely affect decision quality in several areas of aviation. 101 emergency services pilots participated in this research by using an online tool which presented them with three scenarios representative of the types of situations they encounter in their line of work. After each of the scenarios, participants were asked four questions: their willingness to fly the specific scenario, whether a confirmatory factor influenced their decision, and how confident they were in their previous two answers. The findings suggested high levels of confirmation bias across all participants. Whilst the criticality of the scenario presented did not provide a statistically significant difference in the level of confirmation bias of participants, the total number of missions participants decided to fly, and their total emergency services flight hours, did. The findings overall suggest that confirmation bias may adversely affect emergency services pilots' decision-making, leading them to decide to fly based on an unrealistically positive appraisal of information relevant to making a decision. The findings were broadly consistent with prior research on confirmation bias and aviation decision making and appeared to provide a framework for understanding a number of previous fatal accidents of emergency services aircraft. The main limitation was use of hypothetical scenarios, rather than real life ones, due to ethical and practical implications of conducting this research on real-life missions.

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1. Introduction

1.1 Decision Making in Aviation

Many areas in aviation are highly complex; one such area is pilot's decision making. Decision making is primarily concerned with the identification of problems, and how to respond to them appropriately, often in highly dynamic and ill-informed situations (Morrow et al., 2008). The decisions that pilots make are required to be both timely and applicable to the situation in order for the flight to be safe and on schedule (Schriver et al., 2008). As a pilot is exposed to, interacts with, and generally experiences different flights, mission types, and environmental conditions, their knowledge patterns form, which in turn form the basis for their decision-making processes (Rowntree, 2012). Such exposure to different scenarios, situations, and conditions allows pilots to have a larger knowledge and experience base to draw upon when making decisions (Adams, 1993). The scenarios faced by emergency services pilots and the literature reviewed below surrounding the cognitive challenges they face are complicated and, at times, conflicting. Through gathering data as to how pilots perceive mission pressure and how different cognitive biases influence their decision making, it is intended this research will gain a greater understanding of the extent to which such influences occur, and whether pilots perceive such influences to be of a concern to flight safety.

1.2 Emergency Services Aviation

Emergency services aircraft operations (i.e., medical, search and rescue, police, and firefighting) is based around the utilisation of aircraft to expand the capabilities of the emergency service which the aircraft and their aircrews serve. In the medical context, Helicopter Emergency Medical Services (HEMS) operations combine helicopter flight crews with advanced paramedics and, at times, emergency doctors to provide intensive care level pre-hospital capabilities. Clear clinical benefits come from the use of helicopters in such situations (Ringburg et al., 2009), and examples include airlifting patients experiencing cardiac arrest from remote locations, or victims of motor vehicle accidents, to major trauma centres capable of handling their clinical needs. Search and rescue (SAR) helicopters are sometimes combined with HEMS operations, and other times operate as standalone platforms dedicated to providing aerial search and rescue capability, both in the offshore and onshore fields (Grissom et al., 2006; Liu et al., 2021). SAR operations provide an effective and efficient platform to conduct an extended search for a missing person(s), and upon location, utilise specialist equipment such as a rescue hoist mounted to the aircraft to extricate and transport them to an appropriate location depending on their condition. For example, onshore, the users of this service may include missing hikers on a mountain, and offshore, mariners onboard a sinking or unsafe vessel. Police aviation utilises mission-specific equipment such as infrared cameras and tracking systems, operated by highly trained police officers, in aircraft flown by either civilian or sworn police pilots to provide an aerial capability to the majority of frontline and specialist policing operations (Bennett, 2019). Taskings for police aircraft can include anything from routine surveillance, tracking stolen vehicles or criminals, to transporting tactical teams to locations or events requiring their intervention. Finally, firefighting aircraft, both rotary and fixed wing, provide an extremely effective aerial platform for fire suppression, both in the initial and sustained attack phases, primarily for rural bushfires (Marchi et al., 2014). During the 2019-2020 bushfire season in Australia, referred to as the Black Summer, firefighting aircraft played a critical role in fire suppression. The common theme across all sectors is the integration of aircraft into the existing operations, to provide rapid, capable, and unique capabilities to enhance the emergency service.

Pilots of emergency services aircraft will often face highly stressful situations which require them to make consequential decisions which constantly balance the direct safety and survival of their crew and attempting to ensure they have the intended life-saving or life-impacting influence on the emergency they have been dispatched to (Carchietti et al., 2011). As such, the pilots are often faced with making critical decisions whilst having to factor in both significant aeronautical and emergency services elements (Harenberg et al., 2018). Cognitive heuristics and their resulting biases are being studied as they have been found to have a pervasive influence on the decision making of individuals in a variety of professional contexts (Croskerry, 2013; Walmsley & Gilbey, 2016), and greater understanding can assist emergency services pilots in minimising their impacts, resulting in safer decision making.

1.3 Systems of Thinking and Schemas

Kahneman (2011) described a dual-system theory of thinking, named System 1 and System 2, whereby System 1 is the automatic, quick, and almost involuntary method of thinking, and System 2 is the focussed, effortful, and analytical thinking. In situations involving high levels of stress, cognitive workload, and/or difficulty, System 2 thinking will rely upon System 1 thinking to complete the task. In addition to at times answering easier questions than what it was asked and having a lower level of logical and statistical comprehension, System 1 thinking has biases which make it prone to make systematic errors (Kahneman, 2011). For a new pilot, one may anticipate that System 2 thinking would conduct a high proportion of the thinking, especially in non-standard scenarios, as the situations they are facing are relatively new. Conversely, these pilots will also be under high levels of pressure due to the factors mentioned above, and therefore may have to make quicker decisions due to such pressures, allowing for System 1 thinking to take over.

For an experienced emergency services pilot who faces critical missions on a regular basis, it could be expected that System 1 thinking would have a larger presence and authority over the pilot's decision making. Kannengiesser and Gero (2019) found that when comparing third-year engineering students to the experienced professionals employed by the same university, the professionals used System 1 thinking less than the students, which was opposite to their hypothesis. This demonstrates that pilots may in fact continue using System 2 thinking in critical situations, despite having extensive prior experiences informing and allowing for System 1 thinking, which would minimise the opportunity for confirmation bias to influence their decision making.

Schemas are another key element to this process, as they are essentially a pattern of repeated actions which form as individuals continuously interact with or experience a given scenario (Chen & Mo, 2004). The understanding of schemas is that total knowledge a human has is organised as many networks of information, which are individually or collectively activated as certain situations or scenarios are experienced (Plant & Stanton, 2021). Therefore, as argued by Klein (1998), effective decision making in a situation such as in an aircraft's cockpit requires intuition more than analytical knowledge, and schematic processing is more influential upon intuition than analytical knowledge. From the description above, one may be able to draw parallels and similarities between Schemas and the Kahneman and Tversky model of Systems of Thinking.

1.4 Biases Influencing Decision Making

Cognitive biases have been found to have a greater than normal influence on the decision making of professionals who work in public safety (Fishbach & Finkelstein, 2012), such as the emergency services mentioned earlier. Also, the potential for a positive outcome in a negative situation, which is regularly faced by emergency services aviation professionals, further influences decision making (Lewis & Simmons, 2020; Sezer et al., 2016). An additional complication to the decision-making process for emergency services pilots, whose missions are often in the public eye, is that the social acceptance of the outcome has also been found to have an influence over decision making (Agrawal & Maheswaran, 2005). These elements, either combined or individually, create significant pressure which is placed on the pilots and their decision making, which is already taking place in a highly stressful and emotional context.

Pressure to complete a flight is demonstrated by Bauer and Herbig (2019), who found that 36% of the Helicopter Emergency Medical Services (HEMS) pilots from the United States they surveyed reported that they pressured themselves to begin or complete a flight either sometimes or often. Also found by Bauer and Herbig (2019), was that 21% and 24% of pilots reported being pressured to begin or complete a flight by management and medical air crew respectively. A potential explanation for the higher percentage of self-pressure is from Bartling and Fishbacher (2012), who concluded that the reward associated with making a decision, especially one with a positive outcome, means an individual, or in this case a pilot, is more likely to want to make the decision themselves. Also, the HEMS and Helicopter Air Ambulance (HAA) market in the United States operates under a markedly different structure than most other countries, which is explored further below in the accident investigation analysis. Therefore, further investigation into a pilot’s susceptibility to, and their decision making under such pressures, could assist in gaining greater understanding of similar situations.

Pilots face a variety of pressures, both external and internal, when completing an emergency services mission. Whilst pilots may be able to complete many critical flights without consequence, in situations when an accident or avoidable fatality occurs, if the pilots were able to identify and minimise the impacts of such pressures and biases in real time, the accident and/or fatality(s) could have been avoided. Therefore, the focus of this research is to understand the levels of the primary cognitive biases that influence pilots' decision making to fly in conditions or situations that they perhaps would not fly in given a less critical mission.

Pilots may find themselves making a decision for the purpose of adhering to public perception and either avoiding the need for, or minimising the impact of, pressure from management and/or flight crew. However, given that aviation is highly regulated with strict boundaries, pilots may not be susceptible to the same factors due to fear of losing their license and/or prosecution for operating outside of those boundaries. Medical professionals, who a lot of the existing literature studies are focussed on, are also subject to strict licensing requirements and have the potential to lose their ability to practice in severe situations, giving validity to the possibility that when in a situation of high cognitive workload and high levels of outcome and consequence potential, professionals may still make decisions they would not in a less critical situation. Sezer et al. (2015) found that unintended unethical behaviour is more likely to occur when people are either cognitively busy or tired, as their reliance on automatic, fast, and intuitive processing increases, further demonstrating the possibility of pilots' decision-making being influenced by cognitive biases in high stress and high cognitive workload emergency situations.

1.5 Influence of the Potential Outcome

Outcome bias is an extensively researched and discussed topic, catalysed by the research of Daniel Kahneman and Amos Tversky. In their early research, Kahneman and Tversky (1974), found that there is unwarranted confidence produced when a potential positive or negative outcome is paired with the information informing an individual's decision making, also called the illusion of validity. In the context of this research, this may suggest that pilots may have unwarranted confidence in their ability to safely fly in bad weather when the criticality of the mission is considered during their decision making, based on previous successful experiences of doing so. Gilbey et al. (2016), found that when reporting aviation safety concerns, pilots may not report a concern if the eventual outcome of that concern is not significant. A factor in this is the reality of flight, in that it is very dynamic and ever-changing, and that a pilot may not be able to report a concern until post-flight, at which point the event has occurred. If the concern did not eventuate, then the concern's impact is minimised and the pilot is less likely to report it.

The above possibility is shown further by Baron and Hershey (1988), who found that outcome bias was present in their experiments involving medical doctors, and partly explained such presence through the participant focussing on the positive outcome that can be accomplished through one or more decisions that can be made, when making their decisions. Kahneman and Tversky (1984) found that decision value, where the attractiveness of the potential decision is influenced by the intended outcome, and experience value, the levels of pain, pleasure, anguish, and satisfaction in the outcome, are key elements of the decision-making process, however their proportions are neither consistent nor similar across the population. Therefore, it can be reasonably assumed that emergency services pilots will likely make different decisions based on their individual interpretation of the situation and the value they place on certain aspects, however, if a positive outcome is possible, there is a reasonable chance they will make the decision that has the largest positive outcome.

Another result from Kahneman and Tversky's later research found that people are more likely to take on additional risk when the reward is greater (Kahneman & Tversky, 1979). This suggests that in, for instance, a scenario where a Search and Rescue (SAR) pilot is making their decision of whether the weather conditions are safe enough to fly offshore to a capsized vessel, the high level of reward in rescuing the vessel's crew and giving them the best chance of survival possible means that, according to the aforementioned research, they are more likely to take on additional risk of perhaps flying in weather conditions they would not if the vessel had not capsized and the crew were not in the water. Savani and King (2015) define outcome bias in a similar way, in that when evaluating a decision, people tend to perceive the decision more favourably when the outcome is positive rather than negative. Therefore, if pilots have successfully completed a similar mission, or a mission in similar weather conditions, previously, this has a reasonable potential to influence their decision making in the present.

Gino et al. (2009) concluded that when making a decision, too often the outcome, i.e., the patient's survival in the scenario below, is judged to be the critical factor, rather than the process of making a decision. If a HEMS pilot is informed by the flight medic that the patient's injuries will be fatal if they are not flown to hospital, given that the flight medic is a valid and reliable source of information, the pilot may be overly influenced by the potential outcome of saving this person's life and decide to fly in deteriorating or unsafe weather conditions as the outcome is so significant. Such a scenario could be a contributing factor to the earlier statistics regarding HEMS pilots feeling pressured by their crews, either directly or indirectly, through the gain of information such as the criticality of a patient's injuries.

1.6 Confirmation Bias

Confirmation bias has been described to be a psychological phenomenon that is pervasive and not only uses specific prior knowledge in a way that conforms to pre-existing beliefs, but also creates new evidence to give credibility to such pre-existing beliefs (Kassin et al., 2013).

Nickerson (1998) placed confirmation bias into two key forms: motivated and unmotivated confirmation bias. Motivated confirmation bias is of interest to this study. Motivated confirmation bias is understood to have an influence upon decision making due to two key goals within motivation: accuracy and directional (Kassin et al., 2013). Directional goals within confirmation bias are focussed on where the individual making the decision is in search of a specific preferred conclusion (Kassin et al., 2013). Kunda (1990) found that with the directional goals within confirmation bias, the *illusion of objectivity* has a strong influence, as it prevents decision makers from identifying the influence that their preferred conclusion has had upon their decision making. This is further demonstrated by Balcetis and Dunning (2006), who found that motivation has a genuine and significant unconscious influence upon perception. In the context of this research, this could be applied to a pilot whose decision making is influenced by the preferred conclusion of the mission, such as successfully transferring a critically injured patient to hospital.

Confirmation bias is closely linked with outcome bias, as the pilots participating in this research conduct critical missions regularly, and as such, may find confirmation and outcome biases are intertwined when in the 'heat of the moment.' Confirmation bias is understood to be the tendency of an individual to search for and recollect specific information which confirms their decisions or beliefs leading up to a decision, rather than that which does not confirm their decisions or beliefs leading up to a decision (Jones & Sudgen, 2001). Gupta et al. (2011) found when studying outcome bias that the emergency doctors surveyed were more likely to give scenarios with a positive outcome the benefit of the doubt, rather than negatively reflect on a scenario with a negative outcome. If this principle is reflected in emergency services pilots, such review of previous flights may result in confirmation bias influencing their decision making as their recollection of previous similar situations could be more likely to focus on those with positive outcomes, rather than those with negative outcomes. Furthermore, Tuccio

(2011) determined that when an experience has a significant impact, it is more likely to be remembered.

Orasanu and Strauch (1994) found that in situations with high levels of time pressure, such as those faced by emergency service pilots, individuals are more likely to adopt a decision-making process that utilises recognition, and comparison of the situation to previous situations, and implement the process that resulted in a positive outcome in that situation. For an emergency service pilot, when faced with deteriorating weather combined with a critically unwell patient or high-risk policing incident, they may utilise a previous experience where boundaries were pushed but a positive outcome was achieved to inform their decision-making. While they may be able to achieve a positive outcome again, the risk associated with doing so is high and has a potential for fatal consequences. Kappes et al. (2019) believe that it is human nature to discount evidence or information which undermines previous decisions, which could potentially be the reasoning in a pilots' decision making in the situation described above. These points are further highlighted by Lehner et al. (1997), who state the basis for confirmation bias is when individuals locate and concentrate on confirmatory information or evidence which allows for a decision to be developed, and then generally discounting evidence which is disconfirmatory to that decision.

Therefore, it can be reasonably seen that a significant mission flown by an emergency services pilot, for example a successful transfer of a critically injured motorist from an accident to a trauma centre in bad weather, is likely to not only be remembered by the pilot, but used in future situations, perhaps in similar bad weather conditions, to inform their decision making, as they have previously completed a similar mission successfully. In the same scenario, a pilot is less likely, based on the evidence above, to utilise an experience, where perhaps the mission was carried out unsuccessfully in bad weather, to inform their decision making. If the patient on the unsuccessful mission died, it may be more significant for the pilot and therefore may be remembered more vividly, however this potential situation could be countered by the earlier positive outcome perception discussion, where the pilot may decide they do not want to be in a similar situation again and allow that to influence their decision making. What is certain is that these situations are highly dynamic and consequential, with each pilot bringing a wealth of different experiences and viewpoints to their decision making.

A study by Gilbey and Hill (2012), on which this research is based, found in four of their five studies that participants used confirmatory strategies to make their decisions, and in doing so, provided a false positive result. In the context these studies took place, navigating while lost in general aviation flying, the potential for an unsafe outcome was increased, and parallels were able to be drawn to previous aircraft accidents (Gilbey & Hill, 2012).

1.7 Pilot Personality and Mental Health

Winter et al. (2021) identified openness and extroversion as some of the key personality traits of pilots, whereby an element of openness is the potential to make decisions based on ‘gut’ instinct, and extroversion is the tendency to make quick and sometimes spontaneous decisions with outcomes that are action orientated. When these key elements are combined, it can be seen that there is a strong possibility that pilots of emergency services aircraft may make quick, positive outcome focussed, and instinctual decisions, which may well be completely safe and in the best interests of both the crew and the patient/beneficiary of their flight but could also be biased towards unsafe decisions that are too heavily outcome focussed. While it would be inaccurate to assume that all pilots have the same personality, these key traits have been identified as common within pilots.

Pilots who fly emergency services aircraft are exposed to the critical aspects of the emergency service they operate on behalf of, such as severe traumatic injuries, mass casualties, and mental health, which can have serious implications on the pilot's own mental health and comprehension of extreme events (Wankhade et al., 2020). Despite such exposure, a study of western Canadian HEMS crews found that the crews had generally low rates of depression, anxiety, stress, and post-traumatic stress disorder (PTSD), at a rate that is representative of the general population (Harenberg et al., 2018). As such it can be reasonably understood that the decisions made by emergency services pilots are rational and not impaired by such mental health matters to an extent that is greater than the general population.

1.8 Decision Making in Aircraft Accidents

The literature reviewed so far gives depth and understanding to the issues of how cognitive biases influence decision making, especially that of emergency services pilots. However, an analysis of investigative and safety reports from emergency services aircraft accidents gives greater context, applicability, and understanding as to how such biases interact with the missions that are carried out by emergency services aircraft and crews, and why minimising the risks in this sector of aviation is vital to reducing accident and fatality rates.

1.8.1 New Zealand Firefighting Helicopter Accident

The fatal crash of a firefighting helicopter, ZK-IMB, in the Northland region of New Zealand on 30 November 2011 sets a strong foundation for this analysis. The Salt Air aircraft, flown by a highly experienced helicopter pilot with over 17,000 flying hours, was dispatched to fight a fire late in the evening, with a setting sun, low visibility, and sub-optimal weather conditions, which were observed and acknowledged by the pilot en-route to the scene, who told the Chief

Executive of his company that: *"…the weather didn't look good…I don't know how much I am going to get done…"* (Civil Aviation Authority of New Zealand, 2013, p.7). Despite such reservations and acknowledgment of difficult weather conditions, the pilot continued fighting the fire for 48 minutes, before receiving an urgent request from the New Zealand Fire Service Northern Communications Centre (Northcom) to locate and rescue members of the public who were being forced into the ocean by the fire (Civil Aviation Authority of New Zealand, 2013). Continued urgent requests to rescue to members of the public came from Northcom while the pilot and his passenger were trying to locate them, before the pilot entered the smoke layer, estimated to column from ground level to approximately 500 feet, lost spatial orientation, and impacted the ocean, killing both the pilot and the passenger (Civil Aviation Authority of New Zealand, 2013).

Given that the pilot was highly experienced and had been described as someone who was not impulsive nor likely to make unplanned decisions, it is reasonable to question whether the missions being carried out by this pilot had an influence upon his decision to fly in conditions that lead to the spatial disorientation, a conclusion that was also reached in the accident report (Civil Aviation Authority of New Zealand, 2013). The accident report concluded that due to the perceived sense of urgency to locate and rescue the trapped members of the public, the pilot and his passenger did not have, nor did they give themselves, an adequate period of time to properly and effectively identify, manage and mitigate the risks of conducting the rescue mission (Civil Aviation Authority of New Zealand, 2013). As such, it can be seen that even highly experienced and level-headed pilots are susceptible to the criticality of missions having an influence over their decision-making, to an extent that is out of character for them.

1.8.2 Police Scotland Helicopter Accident

A parallel between the fatal crash of ZK-IMB and the widely publicised fatal crash of G-SPAO can be drawn. G-SPAO, an Airbus (then Eurocopter Deutschland) EC135, was a police helicopter operated by a commercial operator on behalf of Police Scotland, which on 29 November 2013 crashed through the roof of the Clutha Vaults Bar in Glasgow, killing the three crew members and seven members of the public (Air Accidents Investigation Branch, 2015). The cause of the accident has been determined to be the mismanagement of the aircraft's fuel system by the pilot, as the pilot acknowledged five low fuel warnings from the aircraft yet did not turn on the fuel transfer pumps, which would have supplied the engines with sufficient fuel as per Standard Operating Procedure, nor follow the required procedure of landing within 10 minutes of such warnings, as required in the *Pilot's Checklist Emergency and Malfunction Procedures* (Air Accidents Investigation Branch, 2015).

Similar to ZK-IMB, the accident flight of G-SPAO involved an evolving and multi-dimensional mission set that developed over the course of the flight, as the aircraft and its crew responded to a total of five taskings (Air Accidents Investigation Branch, 2015). A notable difference between the accidents of ZK-IMB and G-SPAO is that in the accident of ZK-IMB, the urgency and criticality of taskings increased, whereas for G-SPAO, they decreased as the taskings began with a non-standard search for missing persons, and this was followed by four subsequent routine and non-urgent surveillance taskings (Air Accidents Investigation Branch, 2015).

The pilot of G-SPAO, a former Royal Air Force Chinook operational pilot, instructor, and display pilot, was highly regarded and widely considered to be an above-average pilot within a high performing group of aviators, with 5,592 flying hours, of which 646 were on the EC135 (Air Accidents Investigation Branch, 2015).

The accident investigation noted that the fleet of EC135 helicopters operated by this specific civilian operator on a variety of mission types, including police, medical and commercial, had previously experienced false low fuel warning indications, to an extent where 70% of the tested sensors had no fault identified (Air Accidents Investigation Branch, 2015). While it is impossible to say the level of impact it had upon his decision making, it is reasonable to assume that the pilot was professionally made aware of this ongoing incorrect fault, which has a direct link to the cause of the accident. The Air Accidents Investigation Branch (2015) concluded that these indications and subsequent lack of fault diagnosis had the potential to mislead pilots to believing such cautions and alerts were false. Another consideration is the potential that the low fuel audible warning from the aircraft coincided with another audible warning from the mission system alerting the crew to being 2 nautical miles from scene, and the pilot focussing on the mission warning and unintentionally ignoring the low fuel warning, however the caution light illumination would have likely caught the pilot's attention, as would have the four other low fuel warnings (Air Accidents Investigations Branch, 2015).

Given the extensive experience of the pilot, the multiple acknowledged low fuel warnings, and the crew's commencement of a routine tasking after the low fuel warnings, multiple questions remain surrounding the primary cause of the accident. However, it is not unreasonable to conclude, based on the evidence above, that it is highly likely the decisions made by the pilot were a contributing factor. This is especially pertinent given the fact that at the time of the accident report being published, the EC135 fleet worldwide had over 3 million flight hours over a 20-year period, and fuel starvation had not been the cause of a single accident (Air Accidents Investigations Branch, 2015).

1.8.3 United States Helicopter Accidents

Helicopter Emergency Medical Services (HEMS) and Helicopter Air Ambulance (HAA) operations in the United States add another layer of complication and pressure on the decision-making of their pilots: most operators are privatised (Choi et al., 2021). This leads to over-utilisation and excess pressure on the crews to complete profit-generating flights (Choi et al., 2021).

The fatal accidents of medical helicopters Bell 407 N191SF, Bell 407 N502MT, Agusta A109K2 N601RX, and state police search and rescue helicopter Agusta A109E N606SP all have a common theme in their accident investigation reports. The National Transportation Safety Board determined the cause of their fatal impacts into terrain to be the result of entry into Instrument Meteorological Conditions (IMC) under Visual Flight Rules (VFR), during life critical missions, where the pilot's decision-making was influenced by a pressure to accept such missions despite weather conditions not being suitable (National Transportation Safety Board, 2006, 2011, 2020). Of the more than 500 helicopters that operate medical services in the United States, fewer than 15% are equipped with the instruments and crewed with the appropriately instrument trained pilots to operate under Instrument Flight Rules (IFR) (Springer, 2005). Therefore, the entry into inadvertent IMC during their critical mission flights, where the pilots faced pressure to complete them without the proper training or equipment to do so, are prime examples of how a pilot's decision-making may be influenced to an unsafe extent by the mission and wider operational context of flying emergency services aircraft.

1.8.4 Medical Helicopter Accidents

The recent fatal accident of N191SF, a Bell 407 helicopter performing a Helicopter Air Ambulance flight on 29 January 2019, warrants further analysis as it highlights key issues regarding mission pressures and a pilot's decision to fly into IMC. On the flight in question, the pilot flew a mission as soon as she arrived on base (referred to as the flying pilot), which had been accepted by the previous shift's pilot (referred to as the accepting pilot) but had been declined by two other operators due to bad weather, prior to the accepting pilot agreeing to fly the mission (National Transportation Safety Board, 2020). A pre-flight risk assessment had not been completed by the accepting pilot, nor the flying pilot, with the accepting pilot operating under the assumption the flying pilot would complete the *pre*-flight risk assessment after her return, *post*-flight, which has been identified as a significant trend within the operator's culture (National Transportation Safety Board, 2020). In addition to these factors mentioned, the organisation's culture also placed pressure on accepting such profit-generating flights (National Transportation Safety Board, 2020). It is worth noting that Helicopter Air Ambulance (HAA) operations tend to be of a less clinically critical nature, as they are tasked with the inter-facility transfer of patients, rather than the HEMS focus of accident scene to clinical care facility transfer.

On the flight itself, after not checking the weather prior to departure, the pilot entered two cells of snow flurries, during which the pilot would have been flying in IMC, whilst en-route to a hospital to retrieve a patient. While in the second cell, the pilot entered a descending left turn, and due to not arresting the descent rate, impacted trees and subsequent terrain, resulting in her death, and the deaths of the flight nurse and flight paramedic (National Transportation Safety Board, 2020). The pilot had experience in both rotary and fixed wing aircraft flying under IFR, totalling 104 hours of instrument time out of her total 1,855 flight hours prior to being employed by the operator, however IFR flight using the operator's helicopter fleet was not authorised by the Federal Aviation Administration (FAA) in their operations specifications (National Transportation Safety Board, 2020).

In the National Transportation Safety Board (2020) accident report of this flight, current and former pilots highlighted a culture of pressure to accept flights and setting of minimum targets of 30 flights per month per base. Furthermore, the operator had distributed company-specific quick reference guides to local hospitals and fire departments, on which they emphasised different weather minimums to other operators, and that if other operators turned missions down due to weather, they should call the operator as they would accept them (National Transportation Safety Board, 2020). In addition to this pressure, the National Transportation Safety Board (2020) investigation found multiple past and present pilots and medical crew who gave extensive examples of bullying, harassment, and termination of employment of pilots who turned missions down in weather that was unsafe.

The accident rate of HEMS and HAA aircraft in the United States between 2002 and 2005 was of such concern to the National Transportation Safety Board that they commissioned a Special Investigation Report, published in 2006, to identify trends in these accidents, and methods to mitigate them. The findings of the report determined that the pressures of the medical emergency, and commercial pressures from management to accept flights, often resulted in pilots flying missions in unsafe weather conditions, which in most accidents analysed, resulted in the pilot entering inadvertent IMC, losing visual references, and impacting terrain (National Transportation Safety Board, 2006). Baker et al. (2016) analysed HEMS and HAA accidents in the United States between 1983 and 2005 and found that 77% of the accidents that occurred in IMC were fatal, which is substantially higher than the 31% of accidents in Visual

Meteorological Conditions (VMC) being fatal, to the extent that they concluded that bad weather increases the risk of an accident 8-fold. The National Transportation Safety Board (2006) report recommended the development and implementation of operator-specific formal flight risk evaluation programs, flight-following and dispatch operations being formalised, and a retribution-free dual input decision-making process that reduces the influence of just one pilot's decision-making and allows for peer review and critical analysis of the flight's risk, amongst other recommendations.

1.8.5 New Mexico State Police Helicopter Accident

New Mexico State Police operated the Agusta A109E helicopter N606SP, which on 9 June 2009 was conducting a search and rescue mission when it entered Instrument Meteorological Conditions (IMC), despite being operated under Visual Flight Rules (VFR), and subsequently impacted terrain, killing two crew and seriously injuring a third (National Transportation Safety Board, 2011). The accident flight was a search and rescue tasking to locate and extract a missing hiker from an altitude of 11,000 feet in low temperatures, on the cusp of night (National Transportation Safety Board, 2011). The pilot had initially turned the mission down due to bad weather, however four minutes later accepted the mission, despite having completed his full shift in which he flew three missions (National Transportation Safety Board, 2011).

The mission took place in reducing light, and the pilot made several comments to both his on-board spotter and dispatcher that the weather was less than ideal, but that he was going to keep trying until he had at least located the missing hiker (National Transportation Safety Board, 2011). Once on-scene, the pilot himself made the approximate 0.5-mile hike to the missing hiker and carried her back to the aircraft, in near freezing conditions wearing a summer, non-insulated flight suit (National Transportation Safety Board, 2011). Based on a comment made to the dispatcher, the pilot was under the assumption that if he did not manage to fly away from the scene, then the hiker, spotter, and himself would all need rescuing by someone else, which was contradictory to the advice given to the spotter by the local Search and Rescue Commander, who recommended remaining on-scene in the aircraft and using the aircraft to keep warm and out of the elements if it was unsafe to take off (National Transportation Safety Board, 2011).

The pilot had multiple opportunities to abort the mission and return to base, most notably en-route while approaching the scene with the weather deteriorating, whilst attempting any one of his several attempts at landing on-scene, or once he had landed and shut down (National Transportation Safety Board, 2011), as he could have decided to remain with the aircraft overnight or until the weather had cleared. The accident investigation report published by the National Transportation Safety Board (2011) directly stated that an organisational culture within the New Mexico State Police's helicopter operations where the execution of the mission was prioritised over safe operation of the aircraft was a contributing factor of the accident. In addition to this culture, the pilot in question had been described by colleagues as an individual who was a heroic type of person, who disliked having to turn down missions, and was willing on numerous occasions to put the potential to save another person above his own welfare (National Transportation Safety Board, 2011). The pilot had also been described by his colleagues as a pilot who not only did not always analyse a situation fully enough before acting, but also had a lack of aeronautical experience, which he did not understand about himself, and this often caused a lack of self-restraint (National Transportation Safety Board, 2011).

It could be drawn from the National Transportation Safety Board's (NTSB) investigation of New Mexico State Police's Agusta A109E N606SP accident that the pilot frequently put the accomplishment of the mission over the safe operation of the aircraft, and therefore was allowing the missions to influence his aeronautical decision making.

What is highlighted in the accident reports reviewed, and the additional investigative reports and academic literature, is that HEMS and HAA flights in the United States have been exposed to risk that combine the mission-specific pressures seen in other areas of emergency services aviation, with the commercial pressures of for-profit operations that make up many services in the country. Financial pressure has been demonstrated to bias the decision-making of pilots towards less rational and higher risk behaviour (Causse et al., 2013). The federal No Surprises Act provides a step in the right direction to minimise unexpected cost of HEMS and HAA flights being passed onto the patients, however it does not allow for federal or state-level control over such services (Alexander, 2021). The lack of control over the market is due to it being unregulated under the Airline Deregulation Act, which could be amended to allow for federal or state intervention to reduce the unrealistically high charges for these services currently being passed onto patients and insurance companies (Alexander, 2021). The median potential surprise bill for air ambulance charges was found to be USD$21,698 (Hoadley & Lucia, 2021), demonstrating the motivation for management of HEMS and HAA operators to push pilots to accept flights, and why pilots may feel pressured to do so.

1.8.6 Air Method’s Medical Helicopter Accident

The accident of HEMS AS350B2 helicopter N352LN, operated by Air Methods Corporation, a large medical helicopter operator based across the United States, has similarities to the earlier discussed Police Scotland EC135 accident, where identified, acknowledged, and not acted upon fuel starvation resulted in the loss of engine power and a subsequent fatal collision.

The pilot of N352LN on the accident flight had changed aircraft from their standby aircraft, N101LN, to the primary N352LN part way through their shift when N352LN was made available for service by the aircraft engineer (National Transportation Safety Board, 2013). Despite being told at the start of shift that N352LN was not fuelled to the standard level of 70%-, or 2-hours endurance, the pilot did not refuel, nor complete the required pre-flight inspections that would have identified the low fuel levels, prior to departing on the accident flight, and it was on the first sector en-route to a local hospital that the pilot identified the low fuel level (National Transportation Safety Board, 2013).

The decision the pilot made, which was to continue the flight and uplift fuel en-route to the destination hospital at a local airport with the patient on board, was scrutinised by the National Transportation Safety Board. After admitting his mistake in not identifying the low fuel levels in the aircraft, the pilot then proceeded with a very high-risk option to divert to an airport 58 nautical miles from his then-present position at the collection hospital, which was only 4 nautical miles shorter in distance and 2 minutes shorter in flight time than the destination hospital (National Transportation Safety Board, 2013). The pilot had considered and turned down the option to fly by himself to the airport and return to the collection hospital which would have saved weight and therefore reduced fuel burn, and based on the communication between himself and Air Method's communications specialist, had not verbalised any consideration of fuel being delivered by road to his then-present position at the collection hospital (National Transportation Safety Board, 2013).

Earlier in the conversation between the pilot and the communications specialist, the pilot had acknowledged that the distance between the collection and destination hospitals, and the fuel level he had, was "cutting it close" and would need to refuel before reaching the destination hospital (National Transportation Safety Board, 2013, p. 5). With the acknowledgement of low fuel, the need to refuel based on the distance to the destination hospital and current fuel levels, and the very small difference in distance and flight time between the destination hospital and the refuelling airport, the pilot still made the decision to proceed with the mission, carry the patient and two medical flight crew members, and push the limit of the aircraft's fuel. Examination of records by the National Transportation Safety Board determined the pilot was highly likely aware he did not have required fuel to successfully fly to the refuelling airport, and that he purposely altered his records to give the appearance he would not being utilising minimum fuel reserves to accomplish the flight (National Transportation Safety Board, 2013).

In addition to his perception as a reliable pilot and employee, the time pressures associated the with patient's medical condition, and subsequent extended time required for fuel to be delivered by road to the collection hospital, have been identified by the National Transportation Safety Board as a potential cause for the pilot to knowingly make the high-risk decision to fly (National Transportation Safety Board, 2013). Plan continuation error, discussed further in a later section, was also identified as a likely influencing factor in the pilot's decision making when airborne and in the last few minutes of flight, where low and eventually no fuel would have been evident, as would the close proximity of the airport as it would have been in-sight for the last few minutes of flight (National Transportation Safety Board, 2013). A worthwhile piece of information is that the pilot of N352LN, while having just over 100 hours flying civilian aircraft, all of which were on the AS350B2/B3 models for Air Methods, was an experienced and respected United States Army Apache attack helicopter pilot (National Transportation Safety Board, 2013). Therefore, the pilot was well versed in emergency procedures and the reality of the consequences of running out of fuel mid-flight. What the pilot was not well versed in, however, was the pressure of flying for a for-profit civilian operation, with a critically unwell patient within touching distance in the aircraft's cabin. With such a lack of experience in flying HEMS operations, it would not be unreasonable to hypothesise that the patient's condition could have had a significant influence upon this pilot's decision to fly and continue the mission despite knowingly not having the fuel to do so, a point also emphasised by the National Transportation Safety Board (2013) in their investigation of the accident.

In contrast to the other United States accidents reviewed thus far, the National Transportation Safety Board (2013) concluded that the pilot of N352LN induced his own pressure, which resulted in his hyper-focus on the refuelling airport and the continuation of the flight and mission, rather than properly consider other options, or land once airborne when his fuel gauge would have been displaying close to, and eventually, zero.

A common theme across the accidents discussed in this section is the dynamic nature of the operational context in which the pilots are making decisions, and failure to adapt their decision making and operational focus to the 'new' reality of the mission and environment it takes place in. Emergency services and aviation are both highly dynamic industries where the operational context of a singular mission can change multiple times, let alone when the two industries are combined as emergency services aviation. Therefore, the theme of failing to adapt to the highly dynamic mission profiles demonstrates the pressures of the mission on the pilot and their respective decision-making capabilities.

1.9 Organisational Safety Culture in the United States

The NTSB investigations into the earlier discussed HEMS and HAA accidents found a similar organisational culture issue to be a frequent cause of accidents, where the missions and the financial rewards of the missions were often prioritised over flight safety. A clear link could be drawn from those accidents to the financial reasons for accepting missions in the HEMS and HAA context, however as police helicopters in the United States are fully funded by their relevant department, albeit to varying degrees based on population (Rushin & Michalski, 2020), the financial pressure is not present, but a similar organisational culture is.

In the period between 1 January 1983 and 30 April 2005, there were a total of 182 HEMS accidents, 39% of which were fatal, resulting in 184 deaths (Baker et al., 2006). Further analysis of these accidents by Baker et al. (2006) shows that the risk of an accident having a fatal outcome is increased eight-fold when they occur in bad weather. The HEMS and HAA accident rates are substantially higher than the accident rate of all helicopters across the United States, with the fatal accident rate of HEMS and HAA helicopters, 1.8 per 100,000 flight hours (Baker et al., 2006) being almost triple that of all helicopters, 0.67 per 100,000 flight hours (Ramee et al., 2021). The target set by the United States Helicopter Safety Team is to reduce the total accident rate to 0.55 per 100,000 flight hours by the year 2025 (Ramee et al., 2021). These figures are substantially different to those in Norway, where a fatal police or medical helicopter accident takes place on average once every 16.6 years (Bye et al., 2018). Therefore, it can be seen, in general, that organisational culture within HEMS and HAA operations in the United States places additional pressure on pilots who are already under high levels of pressure, and this, as demonstrated through accident statistics, often leads of preventable accidents, which do not occur at such a high rate in jurisdictions without the financial pressure.

The combination of federally mandated safety management and operational risk mitigation strategies, with state or federal control over HEMS and HAA operations' commercial strategies could result in such pressures being reduced on pilots with the intention of minimising the influence of outcome and confirmation biases on the pilot's decisions to fly or not.

1.10 Plan Continuation Error

A theme across the accidents reviewed above was the failure of the pilots to adapt their decision making to a changing mission profile and adjust their perceptions of risk and reward appropriately. This phenomenon has been identified in many previous studies and labelled as *plan continuation error* or *plan continuation bias*. According to Leonore et al. (2009), perseveration, which is human error caused by the inability to adapt to changes in the operational context or environment, is disproportionately present in fatal accidents, and is generally observed in a high proportion of accidents where changes, such as meteorological, technical or in this research's context, emergency service related, can and often do occur at any stage of flight.

Orasanu et al. (2001), suggest that their research delves further into the decision-making processes of individuals who are experts and have significant experience in their field, which is what an emergency service pilot could be classed as. A factor in decision error identified by Orasanu et al. (2001), is the failure to simulate consequences, where routine decision-making strategies fail to correctly identify potential consequences, and adjust the decisions being made accordingly, which has the potential to lead to an accident. For an emergency service pilot, the risk of plan continuation error is high, particularly in dynamic scenarios, for example where a patient in the aircraft being transported to hospital starts to deteriorate. The pilot is already mid-flight, with a plan in their head covering the route to hospital, threat and error management, and a large quantity of information regarding the flight itself. With the added pressure of the nature and need of the flight changing, this change could result in cognitive overload as the pilot then has to consider almost every aspect of the flight and how to react to the change in patient status.

This factor is built upon further when Orasanu et al. (2001), found that of 51 accidents reviewed in a National Transportation Safety Board report, 29 of them involved the lack of action by the pilots to do something that should have been done to correct an issue, referred to as an omission. The theory behind such a high rate of omission is the use of a familiar schema to process decisions, and therefore continue with the original plan or standard operating procedure, where an alternative action was required. Reason (1990, p. 46) identified this type of schema as a "strong but wrong," whereby irrelevant but easily accessible decision-making patterns are interpreted incorrectly, leading to an error that would not be an error in the appropriate context, but is incorrect in the context it is used.

In the context of emergency service aviation and the decisions made by pilots, this may be represented by a pilot using a prior experience or standard operating procedure that may be appropriate for a clear weather day and applying it to a time critical mission in low visibility weather. While this may be a routine and highly safe decision to make on a clear weather day, the application of it to low visibility conditions may pose a risk to the safety of flight and should be adjusted accordingly to the conditions presented at the time.

2. Research Focus

2.1 Research Problem

Pilots of emergency services aircraft face extreme levels of pressure, not only aeronautically through the often-precarious weather and environmental conditions they fly in, but also operationally through the types of missions they fly. Being a provider of airborne emergency services, these pilots are often confronted with the reality of frontline emergency medicine, firefighting, policing, and search and rescue. The nature of these emergency services places an additional level of pressure and stress on the pilots, and subsequently their decision making becomes, quite often, a matter of life and death for not only themselves but those they are flying to serve.

Given the environment in which these pilots make their decisions, and the lack of specific research into the decision making of emergency service pilots, the focus of this research is to conduct specific research into the influence of confirmation bias on the decision making of emergency service pilots.

2.2 Research Question

The primary question of this research is: Does confirmation bias influence the decision making of emergency service helicopter pilots?

This research question is then broken down into several sub questions:

1. Is confirmation bias higher in missions of high criticality compared to lower criticality?
2. Does confirmation bias vary between the primary emergency services?
3. Does confirmation bias vary dependant on a pilot's level of experience?

2.3 Hypotheses

The following hypotheses were derived from the preceding literature, problem, and question:

1. Confirmation bias will be significantly higher in pilots flying missions of high criticality compared to lower criticality.

2. Confirmation bias will be significantly higher in the Helicopter Emergency Medical Services (HEMS) sector compared to other emergency service sectors due to the more confronting nature of this type of flying.
3. Pilots with minimal experience (less than 1,000 hours flying emergency services aircraft) will experience low levels of confirmation bias, pilots with moderate experience (1,000 to 6,000 hours flying emergency services aircraft) will experience the highest levels of confirmation bias, and pilots with significant experience (6,000 hours or more flying emergency services aircraft) will experience lower levels of confirmation bias than pilots with moderate experience.

3. Method

3.1 Participants

A total of 101 pilots participated in the research study. The participants were from a variety of operations, primarily in New Zealand, Australia, and the United Kingdom. Four participants were ages 20-29 years, 18 were ages 30-39 years, 22 were ages 40-49 years, 37 were ages 50-59 years, and one aged 60-69 years. One participant had less than 999 total flight hours, three had between 1,000 and 1,999 total flight hours, 13 had between 2,000 and 2,999 total flight hours, 14 had between 3,000 and 3,999 total flight hours, 12 had between 4,000 and 4,999 total flight hours, 13 had between 5,000 and 5,999 total flight hours, 10 had between 6,000 and 6,999 total flight hours, six had between 7,000 and 7,999 total flight hours, three had between 8,000 and 8,999 total flight hours, 1 had between 9,000 and 9,999 total flight hours, and six had 10,000 or more total flight hours.

3.2 Materials

This study utilised scenarios to test the levels of confirmation bias in the decision making of emergency service pilots due to the complexities and ethical implications to gathering such data on actual missions. The materials used in this study were designed to provide the highest levels of consistency across all scenarios possible, and three scenarios were used for each type of participant (for example HEMS with critical missions had three scenarios, Police with less critical missions had three scenarios, and so forth). Scenarios One, Two, and Three all followed a very similar mission profile across each of the emergency services, and the weather conditions, as well as location and temporal information remained consistent across all scenarios. Through maintaining such consistency, the variables were controlled to those being studied, which were the difference in responses by pilots of different emergency service types, and how the criticality of the mission altered responses both within the same emergency service, and between different emergency services.

All three of the scenarios can be found in Appendix A; however, an example of a scenario is detailed below. Words and sentences highlighted in bold indicate which information differed between scenarios across different criticalities/emergency service types, demonstrating consistency across the study. The two underlined answers to Question Three were the confirmatory responses, with the one not underlined being the disconfirmatory response.

*Please imagine yourself in this scenario in the context of your current employment as a **HEMS** pilot.*

*You are a VFR **HEMS** pilot on a routine morning training mission, when your dispatch centre has re-tasked you to a **multiple vehicle accident** which has been given the **highest** priority classification.*

The mission is 70 nautical miles northeast from your present location, and a further 60 nautical miles return flight to the nearest appropriate facility. If road-based resources were to attend, it would take a further 3 hours for the mission to be completed compared to if you were to attend. This would likely result in the emergency resulting in a fatality due to the time required to complete.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Below are the questions which followed all of the scenarios. Highlighted in bold in Question Three are the answers which suggested a confirmatory approach to the participant's decision making.

Question One:

Will you fly this mission?

- *Yes*
- *No*

Question Two:

For the question directly above, how confident are you in your decision?

- *Not confident*
- *Slightly confident*
- *Somewhat confident*
- *Fairly confident*
- *Completely confident*

Question Three:

Listed below are three options, please pick the **one** *you feel would be most influential upon your decision-making in this scenario:*

- <u>*I have previously completed a similar mission and am confident this is similar and can be carried out safely*</u>
- *I might have to enter inadvertent Instrument Meteorological Conditions (IMC) to complete this mission*
- <u>*I understand my limits and know that I can safely fly in these conditions to complete the mission*</u>

Question Four:

For the question directly above, how confident are you in your decision?

- *Not confident*
- *Slightly confident*
- *Somewhat confident*
- *Fairly confident*

- *Completely confident*

This study utilised a between-subjects experimental design aimed at investigating the various levels of confirmation bias in the decision making of emergency services pilots, not only between the four primary emergency service types, but also between critical and less critical mission types. The design of the research was based on a similar study by Gilbey and Hill (2012), which investigated confirmation bias in general aviation lost procedures. The study design is broken down into five key components: an introductory home page, which was reached immediately upon clicking the link, the personal information questions, and then scenarios one, two, and three. A brief note at the end of scenario three thanked participants for their participation.

In keeping with Gilbey and Hill's (2012) procedure, participants were asked at the start of each question to imagine the scenario in the context of their current employment as a pilot or the respective emergency service link they were provided with (HEMS, Police, SAR, Fire). The scenarios had enough mission specific detail to appear realistic and representative of a genuine mission, but generic enough and omitting enough detail to allow the pilots to draw their own conclusions about the mission, identify parallels to their own experiences, and consider elements not detailed that are critical to their decision-making processes.

A pilot study was undertaken, with Flight Instructors from the Massey University School of Aviation, and a former emergency services pilot known to the researcher partaking, to ensure the materials were accessible, relevant, and engaged with in the way intended to ensure the design of the research did not negatively impact the results. Feedback from the pilot study was taken on board to fine tune the design.

3.3 Procedure

Participants were recruited to the study through direct contact with established and experienced emergency services aircraft operators, primarily through senior pilots, managers, and directors of said operators. As the target participants were emergency services aircraft pilots, directly contacting the operators of such aircraft meant pilots of non-emergency services aircraft, and non-pilots, were not unintentionally recruited into the study.

When establishing contact with the emergency service aircraft operators, a research proposal was attached, which outlined the key aims of the study, method of gathering data, and the requirement from the operator and their pilots. From there, the operators who agreed to participate were provided with a generic link which their pilots could use to access the Qualtrics survey site. When providing the link to the operators for internal distribution, it was emphasised that participation was completely voluntary, and that message was re-emphasised on the introductory landing page of the survey, which also highlighted the ability to leave the study at any point, as well as strict anonymity.

Different links were provided to operators based on the type of emergency service they operated aircraft on behalf of. The four key emergency service types, police, fire, medical, and search and rescue, had separate links, however that was the only differentiation between links to maintain anonymity. The study was designed to be completed on either a computer or a mobile device (e.g., iPad) with ease, simply by clicking on a generic link provided to their employer once the employer had agreed to participate.

Participants were, upon clicking the generic link provided to their employer, randomly assigned to one of two levels of criticality: critical or less critical. The introductory landing page was the same for both levels, as well as all emergency service types, and provided information about the study and important information for the participants such as the emphasis of participation being voluntary. The next page had three questions, which were also the same for all participants, and asked for age (in an age range bracket), total flight hours, and total emergency services flight hours, both in brackets of one-thousand-hour increments.

After answering these questions, the participants were provided with three realistic scenarios, one at a time, all of which followed the order of contextual information (time of day, mission type, priority classification), location and temporal information critical to the mission's context, and weather information. After reading the scenario, four questions followed, which can be found in their true format in Appendix A.

The first question asked whether the participant would fly the mission, with a simple yes or no option available to select. Directly after, they were asked how confident they were in their decision of whether to fly the mission or not, on a five-point Likert scale with the following options: not confident, slightly confident, somewhat confident, fairly confident, and completely confident.

The third question focussed on confirmation bias in their decision making, as they were asked to select one of three options which would be most influential upon their decision making. The options were:

1. I have previously completed a similar mission and am confident this is similar and can be carried out safely.

2. I might have to enter inadvertent IMC (Instrument Meteorological Conditions) to complete this mission.
3. I understand my limits and know that I can safely fly in these conditions to complete the mission.

Options one and three were the responses which indicated a confirmatory approach, whereas option 2 was the option which indicated a disconfirmatory approach. For all participants, the order of responses the question three was randomised, whereas for all other questions, they remained in the order shown.

Following this question, the question regarding how confident they are in their decision is repeated, but this time regarding question three, with the same five options available. These questions remained consistent across all scenarios.

The required minimum number of participants was $N = 78$ and was calculated *a priori* with an effect size of $d = 0.65$, $\alpha = 0.05$, to provide experimental power ≥ 0.8 for a between subjects t-test. The effect size used was the calculated mean effect size in a similar study by Gilbey and Hill (2012).

The research conducted was deemed to be low risk and therefore a low-risk notification was recorded on the Massey University Low Risk Database, which is reported in Massey University Human Ethics Committee's annual report.

4. Results

By the end of the date scheduled for completion of data collection 101 responses had been recorded; of these, initial screening revealed that 18 were incomplete, leaving a final sample size of N = 83. Of the 83 completed responses, 50 were Helicopter Emergency Medical Services (HEMS) pilots, 29 were Police pilots, 3 were Search and Rescue pilots, and one was a Firefighting pilot. From the 83 participants, 44 were randomly assigned to the critical scenario set, while the other 39 participants were randomly assigned to the less critical scenario set.

Answers which indicated a confirmatory approach were given a value of 0, whereas answers indicating a disconfirmatory approach were given a value of 1. Consistent with Gilbey and Hill (2012), higher scores were likely to indicate a safer approach to decision making. Therefore, across the three scenarios, pilots who answered all scenarios with confirmatory answers would receive a total score of 0, whereas a pilot who answered all scenarios with disconfirmatory answers would receive a score of 3.

The mean score of confirmation bias was calculated across all participants (N = 83), and the mean number of disconfirmatory choices was (M = 0.301, SD = 0.837). Single sample t-test revealed that the mean number of times a disconfirmatory choice was chosen by each participant was statistically significantly below what would be expected by chance, $t(82) = 7.605$, $p < .001$, $d = 0.837$.

A one-way analysis of variance (ANOVA) was conducted to calculate the difference in confirmation bias that was shown between critical and less critical scenarios, however the difference was not statistically significant, as $F(1, 81) = 2.756$, $p = .101$, $f = 0.180$. Pilots assigned to critical scenarios (N = 44) had their decisions influenced by confirmation bias (M

= 0.159, *SD* = 0.645) more than pilots assigned to less critical scenarios (n = 39, M = 0.462, *SD* = 0.996). (For one-way ANOVA calculations, Cohen's f statistic was used for effect size, which Salkind (2010) recommends as an appropriate statistic to use for one-way ANOVA calculations due to the fact it measures the mean effect size across the independent variable).

Pilots were asked whether they would fly the mission presented in each of the three scenarios. 'Yes' answers were given a value of 1, and 'no' answers were given a value of 0. Therefore, a pilot who would fly all three missions would get a score of 3, whereas a pilot flying no missions would get a score of 0, and the relevant scores for those who chose a mixture of both yes and no. Across all participants (N = 83), there was a high level of pilots choosing to fly the missions (M = 2.434, *SD* = 1.038). Single sample t-test demonstrated this level of choosing to fly the mission was statistically significantly above what would be expected by chance, (test value = 1) $t(82) = 12.581$, $p < .001$, $d = 1.038$.

One-way ANOVA was conducted to determine the total number of missions pilots would fly and compare the relevant means by whether they were assigned to critical or less critical missions. Pilots assigned to critical missions (N = 44) flew more missions (M = 2.705, SD = 0.765) than those assigned to less critical scenarios (N = 39, M = 2.128, *SD* = 1.218), which was statistically significant, $F(1, 81) = 6.824$, $p = 0.011$, $f = 0.283$.

One-way ANOVA was used to test for differences in the results for pilots of different emergency services. Police pilots (N = 29) were far less likely to fly a mission (M = 1.655, *SD* = 1.317) than HEMS pilots (N = 50, M = 2.860, *SD* = 0.495), which was statistically significant, F (3, 79) = 12.092, $p < .001$, $f = 0.584$. Single sample t-test for Police pilots showed this was statistically significantly above what would be expected to occur by chance, $t(28) = 2.679$, p =

.012, $d = 1.317$. Single sample *t*-test for HEMS pilots showed this was statistically significantly above what would be expected to occur by chance, (test value = 1) $t(49) = 26.555$, $p < .001$, $d = 0.495$. Only HEMS and Police samples were tested as they were of sufficient size to test.

There was no evidence to demonstrate a statistically significant difference in confirmation bias between HEMS and Police pilots, however an effect size of $f = 0.223$ was discovered from one-way ANOVA.

Pilots were asked to provide a rating of confidence in their decisions, on a five-point Likert scale of *not confident, slightly confident, somewhat confident, fairly confident,* and *completely confident*. This was adapted from Timur and Tasar (2011), and the options had a value of 1 through 5 respectively. Pilots were asked for their confidence in their decision for both for Question One, whether they would fly the mission; and Question Three, the most significant influence upon their decision, which was the question which gave the confirmation bias responses. There was no evidence to demonstrate a statistically significant difference in the pilots' confidence in their decisions based on whether they fly HEMS or Police missions, however an effect size of $f = 0.101$ was discovered from one-way ANOVA. Of note is the confidence for whether to fly the mission was significantly higher ($M = 13.221$, $SD = 1.725$) than the confidence that they had chosen the 'correct' influencing factor ($M = 12.321$, $SD = 2.072$), $F(7,75) = 20.459$, $p < 0.001$, $f = 1.227$.

Pilots were asked how confident they were in their decision regarding the influencing factor, which was the confirmation bias question, and a one-way ANOVA concluded that the difference was not statistically significant as $F(3, 79) = 1.771$, $p = 0.159$, $f = 0.231$. HEMS pilots ($N = 50$) demonstrated a higher level of confidence ($M = 13.680$, $SD = 1.835$) than Police pilots ($N = 29$, $M = 12.656$, $SD = 2.410$).

There was no evidence to demonstrate a statistically significant difference in the pilots' confidence in their decisions based on whether they had critical or less critical scenarios, and a minimal effect size of $f = 0.022$ was discovered from one-way ANOVA. This lack of statistical significance was also found when comparing the differences in confidence for the confirmation bias question, however one-way ANOVA resulted in a larger effect size of $f = 0.129$.

The levels of confirmation bias were measured for the pilots who chose to fly no missions ($n = 10$, $M = 2.000$, $SD = 1.414$), two missions ($n = 9$, $M = 0.333$, $SD = 0.707$), and three missions ($n = 60$, $M = 0.033$, $SD = 0.181$). Confirmation bias increased significantly between those who flew no missions, and those who flew all three, as demonstrated by a one-way ANOVA, as $F(2,76) = 52.642$, $p < 0.001$, $f = 0.705$. The participants who chose to fly one mission were not included in this test as $n = 4$.

There was no evidence to demonstrate a statistically significant difference in confirmation bias across the entire pilot group based on their age bracket, despite an effect size of $f = 0.223$.

There was no evidence to demonstrate a statistically significant difference in confirmation bias across the entire pilot group based on their total flight hours, despite an effect size of $f = 0.248$.

The levels of confirmation bias across total emergency services flight hour brackets varied significantly, as demonstrated by the results of the less than 999 hours bracket ($n = 25$, $M =$

0.040, SD = 0.200), the 1,000 to 1,999 hours bracket (n = 25, M = 0.280, SD = 0.737), the 2,000 to 2,999 hours bracket (n = 14, M = 0.429, SD = 1.089), the 3,000 to 3,999 hours bracket (n = 7, M = 0.000, SD = 0.000), and the 4,000 to 4,999 and 5,000 to 5,999 hours brackets combined (n = 8, M = 1.375, SD = 1.506), as $F(4,74) = 4.812$, $p = 0.002$, $f = 0.4298$. The pilots in the 6,000 to 6,999 hours bracket (n = 1), the 7,000 to 7,999 hours bracket (n = 1), and the 8,000 to 8,999 hours bracket (n = 1) were not included in one-way ANOVA, however all three participants had a confirmation bias score of 0.

5. Discussion

The first element to be presented in the results was the level of confirmation bias across all participants as this is the basis and fundamental purpose of this study. The total confirmation bias score across all participants was 0.301, and as the p value was less than 0.001, it can be clearly demonstrated that these results are statistically significant. For both this research, and that by Gilbey and Hill (2012), the results were found to be statistically significant.

Further to the confirmation bias scores, the confidence in the participant's decision on whether they chose a confirmatory or disconfirmatory response, referred to as the influencing factor, provides additional areas for discussion. With a range of potential scores of 0 through 15, where a score of 0 would indicate no confidence in the influencing factor in any of the three scenarios, and a score of 15 would indicate complete confidence in the influencing factor in all three scenarios, the mean score across all participants of 12.321 demonstrates high levels of confidence in the influencing factor overall. If low levels of confidence were discovered, in addition to raising questions surrounding pilot decision-making confidence, it could potentially indicate either the scenarios or influencing factors not being representative of the types of missions flown by the emergency service pilots who participated. Winter et al. (2021) earlier highlighted that pilots are likely to make quick and spontaneous decisions based on gut instinct, as a result of some of the key personality traits possessed by pilots. This finding, combined with the high levels of confidence in this study, suggest overall that pilots have relatively high levels of confidence in their decision making.

When breaking down the levels of confirmatory responses between different sub-groups of the participants, some differences were present to varying levels of significance.

Areas where no statistical significance occurred were the difference in confirmation bias between the responses of Police and HEMS pilots, and the criticality of the missions presented in the scenarios. Based on these results, both hypotheses 1 and 2 were not supported. This lack of statistical significance indicates that confirmation bias is high across the two primary fields of emergency service aviation studied, and that regardless of the criticality of the mission, confirmatory factors will continue to influence the decision making of pilots. This result is of particular interest, as across both these areas, criticality especially, a significant difference in the level of confirmation bias was hypothesised to be present. The lack of statistical significance varies from the literature of Fishbach and Finkelstein (2012), and Agrawal and Maheswaran (2005), who highlighted that the potential for a positive outcome in a negative situation, and the social acceptance of the outcome of the mission respectively, have an influence over decision making. Based on the lack of statistical significance in this research, the criticality of the mission, and therefore the potential for a positive outcome in an extremely negative situation and the social acceptance of saving a life, appear not to have a significant influence over the decisions made by the emergency services helicopter pilots.

There could be a variety of reasons as to why there was no significant difference across these two types of pilots; however, two potential reasons are i): that pilots of emergency services aircraft maintain consistent decision making in general, regardless of the type of emergency service they are flying for, and/or ii) that the levels of confirmation bias are already high across all emergency services pilots, and therefore the nature of emergency services aviation is the primary cause for such high levels of confirmation bias, rather than the specificities of the missions themselves. The review of accidents identified a theme across accidents involving emergency services aircraft being the failure to adapt and readjust operational priorities when the context of the mission changed. In addition to being identified in the accident review, Leonore et al. (2009) identified such perseveration to be disproportionately high in fatal accidents where changes in the operational environment occur. These discoveries, partnered with the results from the study itself, could provide greater context to the industry as to the key points at which confirmation bias has historically been fatally influential. This could be highlighted in the accident of Police Scotland's EC135 helicopter G-SPAO, where over the course of the accident flight, the criticality of the missions decreased from an urgent search to routine surveillance (Air Accident Investigations Branch, 2015). This accident varied from the other accidents reviewed, notably the fatal accident of firefighting helicopter ZK-IMB, which arguably saw an increase in criticality and urgency of taskings over the course of its accident flight (Civil Aviation Authority of New Zealand, 2013). However, as indicated by Leonore et al. (2009), change in the operational environment still occurred, therefore the potential for human error to occur at any stage of flight is high. Whilst every accident and its causes are different, this finding, which differs from the hypothesis, indicates that the scope of the research was not wide enough to be able to draw conclusive answers to these differences, and lack of differences, however more research with a more detailed focus on these elements could provide clearer answers.

Another key idea from the accident review is the still significant organisational and financial pressure faced by HEMS and Helicopter Air Ambulance (HAA) operators in the United States, which has been directly identified as contributing factor to several fatal accidents involving these aircraft (Causse et al., 2013; National Transportation Safety Board, 2020). While the HEMS and HAA system in the United States is heavily complex and a source of significant income for many non-aviation and healthcare businesses and funds, and unlikely to change its operating or financial model any time soon, the intended and hoped implication for this identification is highlighting the issue, the fatal consequences of such pressures, and how other countries operate safe, and in some cases commercially viable, operations with far less systemic pressures being the causes of accidents.

A notable, and statistically significant, difference in levels of confirmation bias was between the participants who elected whether or not to fly certain numbers of missions out of the three presented. The 10 participants who elected to fly none of the three missions had a confirmation bias score of 2.000, the 9 participants who elected to fly two of the three missions had a confirmation bias score of 0.333, and the 60 participants who elected to fly all three missions had a confirmation bias score of 0.033. The four participants who elected to fly one mission were not included in the one-way analysis of variance calculation as being a group of fewer than five, an accurate ANOVA could not be calculated. The results demonstrate a significant increase in confirmation bias as the total number of missions flown increased. This provides insight into the fact that those who chose to fly none of the three missions had an extremely low level of confirmation bias, 2.000, especially when compared to the mean across of participants, 0.301, where total participant confirmation bias score was 664.7% higher than the sub-group who decided to fly none of the three missions. These results indicate a relationship whereby pilots who are less likely to use confirmatory information when making the decision on whether to fly a mission or not appear to be more cautious when it comes to deciding whether to fly or not. Adams (1993) states that exposure to different scenarios allows for a wider experience base, which in turn increase the knowledge patterns which form the basis for decision making (Rowntree, 2012), and Lehner et al. (1997) state that confirmation bias stems from focusing on confirmatory evidence when making a decision and discounting the disconfirmatory evidence. Therefore, as the more cautious pilots may accept fewer high-risk missions, their experience base of previously completing a mission in borderline conditions could be lower than that of their less cautious colleagues who more often accept missions of such a nature.

A key implication from the results above is that the types of pilots who are more likely to accept a mission are also more likely to be influenced by confirmation bias, which in turn provides an exponentially higher chance of confirmation bias having an impact on flight safety as they simply fly more often. The relatively low confirmation bias score of a pilot who is highly likely to decline a mission demonstrates that when deciding whether to fly a mission or not, the primary influencing factor in their decision making is disconfirmatory. This could indicate a decision-making methodology that focuses on the factual, aviation information, while not allowing, or minimising the impact of, the mission related information or previous experiences in similar scenarios to have an impact on their decision, in line with System 2 thinking described by Kahneman (2011). This is demonstrated further by the exponential increase in confirmation bias with the participants who decided to fly two out of the three missions, with a much higher confirmation bias score of 0.333. The significant increase, coupled with the also significant increase in confirmation bias to 0.033 for those who decided to fly all three missions, demonstrates the substantially high influence of confirmation bias upon the decision making of emergency services pilots who decide to fly more missions than they turned down in this research.

This indicates that when making their decision to fly, their previous experiences in similar scenarios and/or the specificities of the mission are having a large impact on their decision making. In the literature review, Gino et al. (2009), Baron and Hershey (1988), and Kahneman and Tversky (1984) all provided insight as to how the outcome of a situation can impact the effectiveness of a decision, and its susceptibility to be biased by said outcome. The above statistics highlight that it could be understood that as a pilot continues to successfully complete high risk, high reward missions, their likelihood to refer to earlier successful missions in their decision-making process increases, and so too does the resultant influence of confirmation bias upon their decision-making. This could also suggest the correlation between the increase in confirmation bias and the decision to fly a higher proportion of the missions, as the higher the influence of confirmation bias, the higher the likelihood to decide to fly a mission than not.

As highlighted in the literature review, Lewis and Simmons (2020) and Sezer et al., (2016), found that when a negative situation has a potential for a positive outcome, such as the ability of an emergency services pilot to save the life of a patient involved in a critical accident, the situation can have an influence over the decisions made by the pilot. Therefore, it appears from the above results, that this theory could have explanatory power in the current study. These theories could also be linked to the number of missions a participant chose to fly or not, and the variations between participants assigned to critical compared to less critical scenarios. Given participants assigned to critical scenarios chose to fly more missions than those assigned to less critical scenarios, and the difference was statistically significant, the theories of Lewis and Simmons (2020) and Sezer et al., (2016) are further supported.

While the total number of flight hours a pilot has logged did not result in a statistically significant difference in confirmation bias, the total number of emergency service flight hours a pilot has did result in a statistically significant difference in confirmation bias. The emergency service flight hour brackets, in one-thousand-hour increments, up to 3,000 hours, saw a steady decrease in, albeit high, levels of confirmation bias. The 3,000-to-3,999-hour bracket had the highest level of confirmation bias, whereas the next two brackets combined (for the purpose of a valid ANOVA) had the lowest level of confirmation bias. These results generally support hypothesis 3. A parallel could be drawn between these findings and the findings of Aherne et al. (2018), who found that pilots with less than six years of experience flying HEMS aircraft were at a significantly higher likelihood of being involved in an accident with a fatal outcome.

The overall trend displayed by these results shows confirmation bias decreasing as pilots gain more experience flying emergency services aircraft. This would suggest that as pilots build more experience in the emergency service field, they develop a wider experience base to draw from when making decisions and have enough exposure to the reality and dynamics of the emergency service they are flying on behalf of to be able to compartmentalise the differing needs of the mission, and those for safe airmanship. These results could be linked with the results of Kannengeiser and Gero (2019), who found that, opposite to their hypothesis, experienced professionals used the quick and almost involuntary method of thinking that is more susceptible to the influence of biases, significantly less than students. As such, the results from this research, paired with the findings of the research mentioned above, it could be seen that confirmation bias, and the potential for it to have a fatal influence, is significantly higher in pilots with lower levels of experience flying emergency services aircraft. What this finding identified is that there is a significant variation in the levels of confirmation bias in pilots as they progress throughout their careers. Of note is the literature of Rowntree (2012) and Adams (1993), which both suggest an increase in experience allow for a greater base to draw from when making decisions as knowledge patterns have formed. The change in confirmation bias, overall trending downwards with an outlying high spike at a high experience point, demonstrates that such understandings may not be straight forward, and the forming of knowledge patterns and experience bases could occur in a nonlinear pattern. However, this finding could provide a positive implication for the industry by setting the basis for targeted human factors training for pilots at different stages throughout their emergency services flying careers, allowing for specific training that focusses on the varying levels of confirmation bias they are likely to be facing, in the relevant context of the experience they have in their relevant field. A later study by Aherne et al. (2019), which expanded on their earlier study, concluded that in the United States, fatal accidents of HEMS aircraft occurred significantly more at night when operating under visual flight rules (VFR). Included in the targeted training for pilots at early stages of their emergency services flying careers could be a focus on Instrument Flight Rules (IFR) proficiency, allowing these pilots to be equipped with the ability to safely recover themselves if they were to enter Inadvertent Instrument Meteorological Conditions (IIMC).

Given the high proportion of confirmatory responses, however the extremely low rate of accidents, it is clear than high levels of confirmation bias do not necessarily result directly in unsafe flying or a higher chance of an accident occurring. Previous experience in high-risk and/or emotionally charged missions can provide a lot of context and background to allow for safe decision making by emergency services pilots. Overall, it is intended that this research has positive implications for the emergency services aviation industry, through identification of areas of improvement when it comes to human factors training, and this research provides insight as to focussed areas that could be targeted for pilots at different stages of their emergency service flying careers.

5.1 Limitations

This study utilised vignettes and scenarios applied broadly to each emergency service field and depended upon participants answering honestly and realistically of how they believe they would act if they were in that specific scenario. Therefore, while all endeavours were made to design the study in such a way that replicated realistic scenarios and elicited genuine responses from participants, the fact remains that this study was online using examples, rather than in the cockpit on a mission, and as a result the findings may not completely reflect exactly how a pilot would react to each of the scenarios in real life or the heat-of-the-moment.

The research was designed for pilots who operate in different jurisdictions and for different companies to be able to complete, therefore some areas, such as company-specific procedures for low visibility operations, had to be left out. If this research was conducted at a scale where each operator could provide sufficient participants to meet statistical minimums, more detailed scenarios could be developed with each of the operators, integrating specific Standard Operating Procedures into the scenarios and focussing on missions sets specifically representative of their operation, which in turn would likely have resulted in more accurate responses.

The number of participants for each type of pilot was lower than what would have been preferred. Helicopter Emergency Medical Services (HEMS) and Police participants were higher than Search and Rescue (SAR) and Firefighting participants and achieving a greater balance of participants from each emergency service, and a higher total number of participants allowing for a more representative and accurate level of participants across the board.

Furthermore, participants came primarily from the United Kingdom, Australia, and New Zealand, where the company culture and limitations, limitations of the relevant jurisdiction, and the type of pilot may vary, even within HEMS or Police pilot groups. The generalisation of pilots into one group based on the type of emergency service they fly for, and the criticality of the scenarios presented, limits the ability to explore differences between countries, companies, and cultures.

5.2 Future Research Areas

The identification of confirmation bias influencing the decision making of emergency services pilots highlights the need for further research into this area. While confirmation bias did not vary significantly between emergency service types or mission criticality, there were two key areas where confirmation bias did vary significantly, with those being experience flying emergency service aircraft, and the number of missions they accepted. Further research into the points at which such levels change throughout careers and experience levels, and the relationship between a pilot's likelihood of accepting a mission and their susceptibility to confirmation bias could provide further insight and ability for targeted training to minimise the influence of confirmation bias.

An extensive amount of research exists surrounding decision making in other areas of emergency services, especially emergency medicine, and decision making of pilots, however limited research exists regarding the decision making of emergency services pilots. While parallels can be drawn between these two safety critical fields, the combination of the two presents its own unique challenges which have limited research. Further research into the unique combination of these fields would provide a greater focus and understanding as to how the combination draws parallels from their respective origins, combine certain existing knowledge in a way which may be expected, but also perhaps provide outputs and influences upon decision making that may not be expected or seen in areas other than emergency services aviation.

Another area of future research could be focussed on how to prevent confirmation bias influencing the decision making of emergency services pilots. Whilst this piece of research adds to the knowledge base in that confirmation bias does in fact have an influence on decision making, it does not address how to reduce or prevent it. This future research could have substantial impacts on reducing the number of fatal accidents involving emergency services aircraft.

6. Conclusion

Even some of the most experienced emergency service helicopter pilots can find themselves vulnerable to confirmation bias having an impact upon their decision making, as this research has shown. Some of the most insightful findings of this research come from areas where the hypothesis was not proven. Areas such as the criticality of the mission not having a significant impact on the level of confirmation bias in a pilot's decision making provide, nor the type of emergency service a pilot flies for, provide insight into the possibility that it is the individual in the situation, rather than the situation itself, that is the most critical factor in confirmation bias being able to have an influence.

What this research has shown is that confirmation bias in general was high across all participants, regardless of mission criticality or emergency service type. When delving deeper into the results, it was shown that the mission criticality nor the emergency service type had a significant influence in the level of confirmation bias present in a pilot's decision making, however, there were significant differences in the level of confirmation bias present in a pilot's decision making based on the total number of flight hours they had flying emergency service aircraft. Another significant finding was the level of confirmation bias varying based on the total number of missions pilots accepted out of the three proposed. With those who accepted all three displaying the highest level of confirmation bias, and those who accepted zero mission displaying the lowest levels, it can be concluded that a pilot who is more likely to accept a mission is more susceptible to confirmation bias.

Questions remain, and some have formed, as a result of this research. Perhaps one of the most pertinent is whether the experience in emergency service flying is linked with the criticality of the mission when it comes to the level of confirmation bias, as pilots develop skills to compartmentalise the two as they progress through their careers.

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Appendix A

HEMS Critical Scenario One

Please imagine yourself in this scenario in the context of your current employment as a HEMS pilot.

You are a VFR HEMS pilot on a mission at 1300 hours during the peak of winter. You are on scene of your mission, where your crew has informed you of a major trauma requiring transport to hospital and have given the mission the highest priority classification.

The location of your mission is 75 nautical miles northeast from the nearest major settlement with the medical facilities you require. Going by road would require a road resource to make the 1.5-hour trip to scene, followed by a 2-hour return transit to the nearest appropriate medical facility. Road-based resources have been determined as not sufficient for the mission due to the extended time required.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

HEMS Critical Scenario Two

Please imagine yourself in this scenario in the context of your current employment as a HEMS pilot.

You are a VFR HEMS pilot on a routine morning training mission, when your dispatch centre has re-tasked you to a multiple vehicle accident which has been given the highest priority classification.

The mission is 70 nautical miles northeast from your present location, and a further 60 nautical miles return flight to the nearest appropriate facility. If road-based resources were to attend, it would take a further 3 hours for the mission to be completed compared to if you were to attend. This would likely result in the emergency resulting in a fatality due to the time required to complete.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

HEMS Critical Scenario Three

Please imagine yourself in this scenario in the context of your current employment as a HEMS pilot.

You are on base as a VFR HEMS pilot when you are dispatched to a significant cardiac arrest, and it has been given the highest priority classification.

The mission is 75 nautical miles northeast from your base, and a further 70 nautical mile return flight to the nearest appropriate facility. If road-based resources were to attend, it would take them 2 hours to reach the scene, followed by a 2.5-hour return transit, which has been determined as not being enough to meet the requirements of the emergency.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

HEMS Less-Critical Scenario One

Please imagine yourself in this scenario in the context of your current employment as a HEMS pilot.

You are a VFR HEMS pilot on a mission at 1300 hours during the peak of winter. You are on scene of your mission, where your crew has informed you of a minor trauma and have given the mission a low priority classification.

The location of your mission is 75 nautical miles northeast from the nearest major settlement with the facilities you require. Going by road would require a road resource to make the 1.5-hour trip to scene, followed by a 2-hour return transit to the nearest appropriate facility. Road-based resources have been determined as sufficient for the mission due to the low priority classification.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

HEMS Less-Critical Scenario Two

Please imagine yourself in this scenario in the context of your current employment as a HEMS pilot.

You are a VFR HEMS pilot on a routine morning training mission, when your dispatch centre has re-tasked you to a low-speed motor vehicle accident which has been given a low priority classification.

The mission is 70 nautical miles northeast from your present location, and a further 60 nautical miles return flight to the nearest appropriate facility. If road-based resources were to attend, it would take a further 3 hours for the mission to be completed compared to if you were to attend.

This is unlikely result in the emergency resulting in a fatality due to the low priority classification.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

HEMS Less-Critical Scenario Three

Please imagine yourself in this scenario in the context of your current employment as a HEMS pilot.

You are on base as a VFR HEMS pilot when you are dispatched to a mild potential cardiac arrest, and it has been given a low priority classification.

The mission is 75 nautical miles northeast from your base, and a further 70 nautical mile return flight to the nearest appropriate facility. If road-based resources were to attend, it would take them 2 hours to reach the scene, followed by a 2.5-hour return transit, which has been determined as sufficient to meet the requirements of the emergency.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Police Critical Scenario One

Please imagine yourself in this scenario in the context of your current employment as a Police pilot.

You are a VFR Police pilot on a mission at 1300 hours during the peak of winter. You are on scene of your mission, where your crew has informed you of an injured police officer requiring your assistance to transport to hospital and have given the mission the highest priority classification.

The location of your mission is 75 nautical miles northeast from the nearest major settlement with the medical facilities you require. Going by road would require a road resource to make the 1.5-hour trip to scene, followed by a 2-hour return transit to the nearest appropriate medical facility. Road-based resources have been determined as not sufficient for the mission due to the extended time required.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Police Critical Scenario Two

Please imagine yourself in this scenario in the context of your current employment as a Police pilot.

You are a VFR Police pilot on a routine morning training mission, when your dispatch centre has re-tasked you to a high-speed pursuit which has been given the highest priority classification.

The mission is 70 nautical miles northeast from your present location, and a further 60 nautical miles return flight to the nearest appropriate facility. If road-based resources were to attend, it would take a further 3 hours for the mission to be completed compared to if you were to attend. This places members of the public at an unacceptably high level of risk due to the time required to complete.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Police Critical Scenario Three

Please imagine yourself in this scenario in the context of your current employment as a Police pilot.

You are on base as a VFR Police pilot when you are dispatched to a remote mission which is to transport a tactical team to a shooting, and it has been given the highest priority classification.

The mission is 75 nautical miles northeast from your base, and a further 70 nautical mile return flight to the nearest appropriate facility. If road-based resources were to attend, it would take them 2 hours to reach the scene, followed by a 2.5-hour return transit, which has been determined as not being enough to meet the requirements of the emergency.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Police Less-Critical Scenario One

Please imagine yourself in this scenario in the context of your current employment as a Police pilot.

You are a VFR Police pilot on a mission at 1300 hours during the peak of winter. You are on scene of your mission, where your crew has informed you of a moderately injured police officer asking for air transportation to hospital and have given the mission a low priority classification.

The location of your mission is 75 nautical miles northeast from the nearest major settlement with the facilities you require. Going by road would require a road resource to make the 1.5-hour trip to scene, followed by a 2-hour return transit to the nearest appropriate facility. Road-based resources have been determined as sufficient for the mission due to the low priority classification.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Police Less-Critical Scenario Two

Please imagine yourself in this scenario in the context of your current employment as a Police pilot.

You are a VFR Police pilot on a routine morning training mission, when your dispatch centre has re-tasked you to a road-speed pursuit which has been given a low priority classification.

The mission is 70 nautical miles northeast from your present location, and a further 60 nautical miles return flight to the nearest appropriate facility. If road-based resources were to attend, it would take a further 3 hours for the mission to be completed compared to if you were to attend. This places members of the public at an acceptable level of low risk due to the low priority classification.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Police Less-Critical Scenario Three

Please imagine yourself in this scenario in the context of your current employment as a Police pilot.

You are on base as a VFR Police pilot when you are dispatched to a remote mission which is to transport a forensic team to a crime scene, and it has been given a low priority classification.

The mission is 75 nautical miles northeast from your base, and a further 70 nautical mile return flight to the nearest appropriate facility. If road-based resources were to attend, it would take them 2 hours to reach the scene, followed by a 2.5-hour return transit, which has been determined as sufficient to meet the requirements of the tasking.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Firefighting Critical Scenario One

Please imagine yourself in this scenario in the context of your current employment as a firefighting pilot.

You are a VFR firefighting pilot on a mission at 1300 hours during the peak of winter. You are on scene of your mission, where your crew has informed you of an injured firefighter requiring transport to hospital. The mission has been given the highest priority classification.

The location of your mission is 75 nautical miles northeast from the nearest major settlement with the medical facilities you require. Going by road would require a road resource to make the 1.5-hour trip to scene, followed by a 2-hour return transit to the nearest appropriate medical facility. Road-based resources have been determined as not sufficient for the mission due to the extended time required.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Firefighting Critical Scenario Two

Please imagine yourself in this scenario in the context of your current employment as a firefighting pilot.

You are a VFR firefighting pilot on a routine morning training mission, when you have been re-tasked to evacuate a local whose rural property has become encircled by fire but has enough space for you to land, which has been given the highest priority classification.

The mission is 70 nautical miles northeast from your present location, and a further 60 nautical miles return flight to the nearest appropriate facility. If road-based resources were to attend, it would take a further 3 hours for the mission to be completed compared to if you were to attend. This would likely result in the emergency resulting in a fatality due to the time required to complete.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Firefighting Critical Scenario Three

Please imagine yourself in this scenario in the context of your current employment as a firefighting pilot.

You are on base as a VFR firefighting pilot when you are dispatched to provide a rapid attack on a spreading fire, and it has been given the highest priority classification.

The mission is 75 nautical miles northeast from your base, and a further 70 nautical mile return flight to the nearest appropriate facility. If road-based resources were to attend, it would take them 2 hours to reach the scene, followed by a 2.5-hour return transit, which has been determined as not being enough to meet the requirements of the emergency.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Firefighting Less-Critical Scenario One

Please imagine yourself in this scenario in the context of your current employment as a firefighting pilot.

You are a VFR firefighting pilot on a mission at 1300 hours during the peak of winter. You are on scene of your mission, where your crew has informed you of a moderately injured firefighter requiring transport and have given the mission a low priority classification.

The location of your mission is 75 nautical miles northeast from the nearest major settlement with the facilities you require. Going by road would require a road resource to make the 1.5-hour trip to scene, followed by a 2-hour return transit to the nearest appropriate facility. Road-based resources have been determined as sufficient for the mission due to the low priority classification.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Firefighting Less-Critical Scenario Two

Please imagine yourself in this scenario in the context of your current employment as a firefighting pilot.

You are a VFR firefighting pilot on a routine morning training mission, when you have been re-tasked to evacuate a local whose rural property is slowly becoming encircled by fire and has enough space for you to land, which has been given a low priority classification.

The mission is 70 nautical miles northeast from your present location, and a further 60 nautical miles return flight to the nearest appropriate facility. If road-based resources were to attend, it would take a further 3 hours for the mission to be completed compared to if you were to attend. This is unlikely to result in the emergency resulting in a fatality due to the low priority classification.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Firefighting Less-Critical Scenario Three

Please imagine yourself in this scenario in the context of your current employment as a firefighting pilot.

You are on base as a VFR firefighting pilot when you are dispatched to provide a rapid attack on a small fire, and it has been given a low priority classification.

The mission is 75 nautical miles northeast from your base, and a further 70 nautical mile return flight to the nearest appropriate facility. If road-based resources were to attend, it would take them 2 hours to reach the scene, followed by a 2.5-hour return transit, which has been determined as sufficient to meet the requirements of the emergency.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Search and Rescue Critical Scenario One

Please imagine yourself in this scenario in the context of your current employment as a SAR pilot.

You are a VFR SAR pilot on a mission at 1300 hours during the peak of winter. You are on scene of your mission, where your crew has informed you that your patient is a hypothermic hiker requiring transport to hospital and have given the mission the highest priority classification.

The location of your mission is 75 nautical miles northeast from the nearest major settlement with the facilities you require. Going by road would require a road resource to make the 1.5-hour trip to scene, followed by a 2-hour return transit to the nearest appropriate facility. Road-based resources have been determined as not sufficient for the mission due to the extended time required.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Search and Rescue Critical Scenario Two

Please imagine yourself in this scenario in the context of your current employment as a SAR pilot.

You are a VFR SAR pilot on a routine morning training mission, when you have been re-tasked to locate and rescue a stranded kayaker requiring extraction, which has been given the highest priority classification.

The mission is 70 nautical miles northeast from your present location, and a further 60 nautical miles return flight to the nearest appropriate facility. If lifeboat resources were to attend, it would take a further 3 hours for the mission to be completed compared to if you were to attend. This would likely result in the emergency resulting in a fatality due to the time required to complete.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Search and Rescue Critical Scenario Three

Please imagine yourself in this scenario in the context of your current employment as a SAR pilot.

You are on base as a VFR SAR pilot when you are dispatched to a sinking vessel with 3 people on board, and it has been given the highest priority classification.

The mission is 75 nautical miles northeast from your base, and a further 70 nautical mile return flight to the nearest appropriate facility. If lifeboat resources were to attend, it would take them 2 hours to reach the scene, followed by a 2.5-hour return transit, which has been determined as not being enough to meet the requirements of the emergency.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Search and Rescue Less-Critical Scenario One

Please imagine yourself in this scenario in the context of your current employment as a SAR pilot.

You are a VFR SAR pilot on a mission at 1300 hours during the peak of winter. You are on scene of your mission, where your crew has informed you that your patient is a mildly hypothermic hiker and have given the mission a low priority classification.

The location of your mission is 75 nautical miles northeast from the nearest major settlement with the facilities you require. Going by road would require a road resource to make the 1.5-hour trip to scene, followed by a 2-hour return transit to the nearest appropriate facility. Road-based resources have been determined as sufficient for the mission due to the low priority classification.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Search and Rescue Less-Critical Scenario Two

Please imagine yourself in this scenario in the context of your current employment as a SAR pilot.

You are a VFR SAR pilot on a routine morning training mission, when you have been re-tasked to locate and extract a tired kayaker requiring who has asked for assistance, which has been given a low priority classification.

The mission is 70 nautical miles northeast from your present location, and a further 60 nautical miles return flight to the nearest appropriate facility. If lifeboat resources were to attend, it would take a further 3 hours for the mission to be completed compared to if you were to attend. This would unlikely result in the emergency resulting in a fatality due to the low priority classification.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Search and Rescue Less-Critical Scenario Three

Please imagine yourself in this scenario in the context of your current employment as a SAR pilot.

You are on base as a VFR SAR pilot when you are dispatched to a vessel with 3 people on board slowly taking on water, and it has been given a low priority classification.

The mission is 75 nautical miles northeast from your base, and a further 70 nautical mile return flight to the nearest appropriate facility. If lifeboat resources were to attend, it would take them

2 hours to reach the scene, followed by a 2.5-hour return transit, which has been determined as sufficient to meet the requirements of the emergency.

There is an approaching weather cell which consists of a 1,500-foot cloud base, 5-kilometre visibility, winds of 19 knots at 050 degrees, gusting up to 33 knots. The temperature is 5 degrees Celsius, and due to drop to negative 3 degrees overnight.

Please answer the questions below based on how you would respond in this scenario. Please remember your answers are completely confidential so answer as accurately as possible.

Response Options

The questions asked and the options for responses, which were consistent across all participants, were as below:

Question One:

Will you fly this mission?

- *Yes*
- *No*

Question Two:

For the question directly above, how confident are you in your decision?

- *Not confident*
- *Slightly confident*
- *Somewhat confident*
- *Fairly confident*
- *Completely confident*

Question Three:

Listed below are three options, please pick the ***one*** *you feel would be most influential upon your decision-making in this scenario:*

- *I have previously completed a similar mission and am confident this is similar and can be carried out safely*
- *I might have to enter inadvertent IMC to complete this mission*
- *I understand my limits and know that I can safely fly in these conditions to complete the mission*

Question Four:

For the question directly above, how confident are you in your decision?

- *Not confident*
- *Slightly confident*
- *Somewhat confident*
- *Fairly confident*
- *Completely confident*