Using mindfulness techniques to improve aviation human factors

by

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Abstract

This report examines the potential use of mindfulness techniques to improve aviation human factors through a literature review of mindfulness in occupational settings, an exploratory study of pilots' perceptions of mindfulness techniques, and recommendations for practical implementation. The implementation section focuses on five main techniques: the setting of intentions before the workday, the use of breath awareness (including *diaphragmatic breathing* and *box breathing*), maintaining an awareness of the role of technology and the balance between tool and distraction, the use of *tactical pause* to improve assessment during aeronautical decision-making (ADM), and mindful listening and speaking for enhanced crew resource management (CRM). Additional applications include situational awareness (SA), the handling of abnormalities, mitigating plan-continuation bias or other biases, crew leadership, psychological resilience, work-life balance, and overall well-being. The exploratory survey found that nearly two-thirds of the respondents had not previously considered mindfulness applications in aviation human factors, suggesting opportunities for broader application. Respondents perceived that the domains related to general well-being—such as stress management, emotional regulation, and quality of life—showed the most promise for improving aviation human factors, although all domains can be mutually reinforcing to aviation human factors. Lastly, the report touches on the challenges of incorporating these practices into modern aviation training curricula, including criticisms, preconceptions, and negative associations with mindfulness practice.

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Acknowledgements

To my loving parents, Phil and Charla.

Introduction

Although mindfulness as used in modern times is often seen as *en vogue* and hailed as a panacea for many of the problems of our technology-oriented era, these techniques—both ancient and contemporary—offer promise to improving aviation human factors. The Federal Aviation Administration (FAA, 2023) defines human factors as "a multidisciplinary field encompassing the behavioral and social sciences, engineering, and physiology, to consider the variables that influence individual and crew performance for the purpose of optimizing human performance and reducing errors" (p. G-15). The aviation environment has always had numerous risks and been unforgiving of mistakes. How crewmembers interact with each other, with the operational environment, and with the aircraft plays an immense role in minimizing these numerous inherent risks. Can mindfulness techniques be applied directly to the processes and typical activities of a pilot's duty day to improve aviation human factors? Which mindfulness techniques are simple, practical, and effective? What are the existing perceptions of mindfulness in aviation human factors? This report synthesizes research on mindfulness in safety-sensitive occupations, examines applied mindfulness techniques, and explores pilots' existing perceptions of mindfulness to provide a concise resource that the researcher hopes is practical across diverse flying environments.

Hypothesis Development

H1: A majority of participating pilots will perceive that mindfulness techniques offer potential to improve aviation human factors.

H2: Pilots with greater flight hours will be less likely to perceive mindfulness techniques as having potential to improve aviation human factors.

H3: Participants will perceive greater potential for improvement in human factor domains associated with general well-being than in the more aviation-specific domains, such as ADM and SA.

H4: Pilots with prior mindfulness practice experience will have more favorable perceptions of the potential application of mindfulness to aviation human factors.

H5: Prior to participating in the survey, most pilots will have limited awareness of the potential application of mindfulness techniques for improving aviation human factors.

Background

Research indicates the benefits of mindfulness in occupational environments and shows that existing techniques can be applied to aviation. This review will examine the role mindfulness plays in other occupations, as well as a few examples already seen in aviation.

Mindfulness Practice Used as an Intervention Strategy in Studies

Several studies specifically apply mindfulness practices as a means of intervention. Bostock et al. (2018) used the popular Headspace meditation app to deliver 45 audio meditations, each lasting between 10–20 minutes, to 239 healthy employees at two large firms in the United Kingdom. The average employee completed 17 sessions over the eight-week period. Although the meditations contained no particular instructions on dealing with work stress, the results indicated an improved affect, decreased job strain, improved perceptions of connection and support, and decreased anxiety and depression. Another study (Meland et al., 2015) documented improvements of stress levels, recovery, and attentional control across two military helicopter units after 4 months of mindfulness training. A review by Zhang et al. (2021) showed that several specific mindfulness-based interventions (MBIs) demonstrated benefits in reducing anxiety, depression, and stress, as well as improving sleep quality, emotional regulation, and overall well-being.

Stress in High-Risk Work Environments

Stress in work environments has been shown to increase the hazards that employees face. A study (Salminen et al., 2014) of 16,385 employees of a Finnish forestry company found that stressed employees were 40% more likely to be hospitalized for a work injury than employees considered low stress. The study ran from 1986 to 2008 and adjusted for age, gender, marital status, and other demographic factors. A review of nurses (Zabin et al., 2023) found a similar negative relationship between job stress and adherence to safety culture. Mindfulness interventions and stress management were recommended to help mitigate the risks found in

health care settings. Holley and Miller (2023) suggested pilots need improved cognitive resilience when facing stressful disruptions, such as "automation surprises" or emergencies and recommended an expansion of stress reduction techniques that could be employed on the flight deck.

Mindfulness and Work-Life Balance

Mindfulness has proven to have a distinct role in improving the psychological well-being of pilots. A study of 130 Turkish airline pilots (Özer & Küçük, 2024) found that higher levels of mindfulness, or conscious awareness, correlated to lower stress and higher life satisfaction. This has an important effect in a safety-sensitive occupation that demands high standards despite continually changing weather, schedules, disrupted circadian rhythms, crew pairings, equipment limitations, and operational environments. A similar study by Arseven & Yurdakul (2024) looked at job satisfaction among 93 Turkish airline pilots and found that personal resources, like psychological capital and mindfulness practice, improved work-life balance and ultimately—although indirectly—improved job satisfaction. Resilience, hope, optimism, and self-efficacy were all positively associated with work-life balance. Practical implications from the study suggested including awareness of psychological capital and mindfulness training to enhance existing risk management systems.

The Role of Technology as a Source of Distraction

Managing advanced technology has long been a central focus in pilot development. A particular piece of technology can play the role of tool, crutch, or distraction. Distractions are a common occurrence while operating an aircraft, but portable electronic devices (PEDs) such as cell phones and tablets, often with continuous air-to-ground internet connectivity, have multiplied the potential sources of distraction. The National Transportation Safety Board (NTSB) singled out the elimination of distractions in its *Most Wanted List of Transportation Safety Improvements* for aviation in 2019–2020, with much of the focus on cell phones. One significant

theme in these distractions is the use of multitasking during flight operations. Task-switching has been proven to impair cognitive function, but it remains a myth held by many pilots that they can multitask and fly safely (NTSB, 2019).

Methodology

This report first includes a brief review of the use of mindfulness in safety-sensitive occupational settings. Google Scholar, OpenAI ChatGPT, and ScienceDirect were used to locate links to peer-reviewed research literature or professional journals, most within the last five years, and all within the previous 12 years. The report then includes an exploratory mixed-methods survey of pilots' perceptions of mindfulness techniques as related to aviation human factors. The survey instrument was created by the researcher in Qualtrics and distributed primarily via the faculty advisor's LinkedIn profile with an associated recruiting message. The survey was open to pilots and student pilots at least 18 years of age and was anonymous. There were 45 total respondents, although many questions had fewer respondents as survey questions were optional and could be skipped. Qualtrics Stats iQ was used to conduct statistical analysis. Research Questions 1, 3, and 5 used descriptive statistics to summarize individual survey responses. For Research Question 2, the test examined the association between flight hours (SQ9) and respondents' perceptions of the potential usefulness of mindfulness techniques (SQ4). For Research Question 4, the test examined the association between prior use of mindfulness techniques in non-aviation settings (SQ2) and respondents' agreement regarding the potential adaptation of mindfulness techniques for aviation (SQ4). Pearson's chi-square (χ^2) test of independence was used in Research Questions 2 and 4 to examine associations between categorical variables against frequencies expected under the assumption of no association. The significance threshold for inferential tests was set at $p < .05$. Stats iQ used Cramér's V to measure the strength of associations, offering additional context beyond statistical significance. Open-ended responses were examined using qualitative coding to identify prominent themes and patterns. The Kansas State University Institutional Review Board (IRB) determined on August 26, 2026, that the study was exempt from further IRB review under Exempt Category 2, Subsection (ii), for research involving human subjects.

Survey Results

The survey results are presented as a series of exploratory research questions, followed by supplemental sections focusing on barriers to adoption and qualitative findings. One consideration in interpreting the data is the relatively small sample sizes within the subgroups. Caution should be used in generalizing the data to the broader pilot population.

Participant Characteristics

The survey respondents represented a range of certificate levels, total flying hours, and flying backgrounds. As shown in Table 1, the majority of respondents hold Airline Transport Pilot (ATP) and Certified Flight Instructor/Instrument (CFI/CFII) certificates, have over 3,000 hours of flying time, and have either an airline or corporate/business flying background. Most respondents are relatively well-experienced, with the highest proportion reporting more than 10,000 hours of flying time.

Table 1. Professional Characteristics of Survey Respondents

Characteristic	Category	n	%
Highest Pilot Certificate	Student	1	2.4
	Sport/recreational	0	0.0
	Private	7	17.1
	Commercial	9	22.0
	ATP	24	58.5
CFI/CFII Certificate	Yes	25	75.8
	No	8	24.2
Total Flight Hours	0-100	3	7.3
	101-500	6	14.6
	501-1,000	3	7.3
	1,001-3,000	7	17.1
	3,001-5,000	5	12.2
	5,001-10,000	8	19.5
	10,001+	9	22.0
Primary Type of Flying	Airline	10	24.4
	Corporate/business	13	31.7
	Flight instruction	5	12.2
	Military	1	2.4
	Recreational	10	24.4
	Other	2	4.9

Note. Percentages are calculated using the valid responses for each item. The highest pilot certificate, total flight hours, and primary type of flying items each had 41 responses. The CFI/CFII certification item had 33 responses considering that only Commercial and ATP certificates are eligible for CFI/CFII certification. This question was only presented to respondents holding a Commercial or ATP certificate.

Research Question 1

What percentage of participating pilots perceive that mindfulness techniques offer potential to improve aviation human factors?

Of the responses (n = 39), 31 participating pilots (79.5%) agreed either somewhat or strongly that mindfulness techniques offered potential to improve aviation human factors or their capacities as a flight crewmember, consistent with H1. Five respondents (12.8%) were neutral, and three respondents (7.7%) disagreed. This survey item was based on a five-point Likert-type scale. For analysis, responses of "Somewhat agree" and "Strongly agree" were combined to indicate greater perceived potential. Additional context for these findings may be supported by SQ5, in which more than half of respondents (53.8%, n = 21) agreed that current aviation human factors training places too much emphasis on abstract theory and lacks relevant day-to-day operational practicality. Although SQ5 does not directly assess mindfulness techniques, it suggests participants are interested in alternative approaches to improving aviation human factors.

Research Question 2

Is flight experience (hours) associated with perceptions of the potential of mindfulness techniques to improve aviation human factors?

The results did not support H2. There does not appear to be a statistically significant association between flight experience and the perception of potential usefulness. A Pearson's chi-square (χ^2) test yielded p = .848 (n = 39). The corresponding Cramér's V = .330 indicates an observed association of modest magnitude, although the result was not statistically significant.

Research Question 3

Which human factors domain do pilots perceive as having the greatest potential for improvement using mindfulness techniques?

As shown in Table 2, respondents believed that stress management (81.6%), emotional regulation (76.9%), and quality of life (71.8%) were the domains showing the most potential for

improvement using mindfulness techniques. These findings are consistent with H3, however, the distinction between domains is not always clear and the domains are not mutually exclusive. This survey item was based on a five-point usefulness scale. For analysis, responses of "Moderately useful" and "Very useful" were combined to indicate greater potential usefulness.

Table 2. Domains Perceived by Pilots as Having the Greatest Potential for Improvement Using Mindfulness Techniques

Rank	Domain	*n*	%
1	Stress management	31	81.6
2	Emotional regulation	30	76.9
3	Quality of life	28	71.8
T4	Aeronautical decision-making	23	59.0
T4	Crew communication	23	59.0
6	Situational awareness	21	53.8
7	Fatigue management	19	48.7
8	Recognition of cognitive bias	17	43.6

Note: Percentages are based on 39 respondents, except for stress management (n = 38).

Research Question 4

Is prior personal experience with mindfulness associated with more favorable perceptions of the potential application to aviation human factors?

An analysis of SQ2 and SQ4 yielded p = .074, indicating there is no statistically significant association between prior mindfulness experience and favorable perceptions of the potential application to aviation human factors, and did not support H4. Although not reaching statistical significance, Cramér's V = .428 suggests a moderate association between the variables. A future study with a larger sample size could provide more precise insight on this relationship.

Research Question 5

To what extent are pilots already aware of the potential applications of mindfulness techniques to aviation human factors?

Nearly two-thirds (64.1%, 25 of 39) of the respondents had not previously considered the potential application of mindfulness techniques to aviation human factors, confirming H5. This may indicate a promising area for further development.

Barriers to Adoption of Mindfulness Practices

As shown in Table 3, the most frequently identified barrier was the perception that mindfulness is unrelated to flying (n = 12, 31.6%), followed by skepticism (n = 10, 26.3%), and lack of awareness (n = 7, 18.4%).

Table 3. Perceived Barriers to Pilots' Adoption of Mindfulness Practices

Barrier	*n*	%
Perception that mindfulness is unrelated to flying	12	31.6
Skepticism	10	26.3
Lack of awareness	7	18.4
Lack of training	3	7.9
Other	3	7.9
Lack of time	2	5.3
Company or social culture	1	2.6

Note. Percentages are based on 38 respondents. Each respondent selected one barrier.

Qualitative Findings

Is there anything else you would like to share about the use of mindfulness in aviation?

Participants were asked on the final survey question to provide an open-ended response regarding the use of mindfulness in aviation. These responses were coded to identify prominent themes and patterns.

Existing Application and Research

Several respondents indicated that mindfulness techniques may already be in use by pilots and instructors, or highlighted previous studies, notably from the Indian Air Force and FedEx Corporation. A flight instructor wrote, “Many flight instructors teach mindfulness techniques, often without realizing it. I have used breathing techniques with students during stressful phases in their training help them reduce stress and find their rhythm.”

An ATP-rated respondent added:

> I am aware of other studies pioneering this area. The Indian Air Force seems to be advanced in this. It links to the use of breathing techniques already in use in some airlines as SOP for startle and surprise.

Performance

Many of the open-ended responses addressed the potential role of mindfulness techniques in supporting pilot operational performance, notably by enhancing focus and situational awareness, and systematic adherence to established procedures. One flight instructor described mindfulness as “consciously taking time to gain a better understanding of yourself and the world around you, it can be thought of as an extension of situational awareness.” An ATP-rated pilot wrote, “I believe that the sterile flight deck tool is a type of mindfulness and is very useful and practical. Other methods of methodical usage of checklists procedures and checklists is another example of mindfulness.”

Well-being

Well-being emerged as a prominent theme in the open-ended responses, particularly in relation to stress reduction and improving quality of life. One respondent emphasized the importance of physical exercise. Although this is distinct from mindfulness practice, the response reflects a broader perspective on pilot well-being that may complement other mindfulness-based approaches.

Barriers

Several responses highlighted barriers to further adoption of mindfulness practices in aviation. One private pilot characterized mindfulness practice as "a soft skill seen as something weak individuals hone" and suggested this perception may conflict with popular stereotypes on the qualities required to be a pilot. One flight instructor expressed similar skepticism, stating, "I don't think it has much of a place in aviation."

Discussion

Although a substantial body of existing research highlights the potential benefits of mindfulness practice in occupational environments, several gaps remain. First, there is very little information about which specific practices are useful. Second, there is even less information about how these practices can be used by pilots or incorporated into training curricula. Third, evidence regarding pilots' perceptions of mindfulness remains limited. Additionally, efforts to implement mindfulness practice in the workplace hierarchy have been uneven, with most efforts directed at the managerial or executive levels and few directed toward the line worker (Martin & Wachter, 2018). This report seeks to help address these gaps by exploring practical applications of mindfulness techniques and examining pilots' perceptions of, and experience with, mindfulness practices.

The researcher was surprised by the broad level of support (79.5%) among the respondents on the potential application of mindfulness techniques, and neither flight experience nor prior personal mindfulness experience seemed to affect this favorable perception.

The domains perceived as showing most potential for improvement to aviation human factors were related to general well-being. These domains were stress management, emotional regulation, and quality of life. The aviation-specific domain that respondents believed showed the most promise incorporating mindfulness techniques was ADM. Techniques applicable to a variety of domains are included in the Mindfulness Practices Applied section.

Despite nearly two-thirds of respondents not previously considering the direct application of mindfulness techniques to aviation before the survey, the open-ended responses suggest that many pilots already employ mindfulness-related practices without explicitly identifying them as such.

To offer a context-rich and diverse perspective across a variety of flying roles, several interviews with pilots could be included in a future extension of this study that might help form a more well-supported conclusion regarding the role of mindfulness in aviation human factors.

Mindfulness Practices Applied

Building a Foundation First

To effectively implement any system or habit, it is important to ensure a solid foundation. A web article from *Mindfulness and Safety Professionals* (2022) highlights seven important elements to build a foundation of mindfulness:

- Eat well and often enough
- Hydrate
- Get a good night's sleep
- Rest throughout the day
- Relax
- Play
- Engage in relationships/conversations

There is a strong overlap in the above list with the well-known *I'M SAFE* acronym (*Illness, Medication, Stress, Alcohol, Fatigue,* and *Eating/Emotional*) used as a self-assessment tool by pilots to evaluate their own fitness and readiness before flying. It is unlikely many pilots associate this acronym with mindfulness, but it can be important to conceptually associate the two sets of elements.

The Setting of Intentions

Many people are familiar with workplace goal setting, but less common is the use of intentions. What is the difference between a goal and an intention? A goal is a specific outcome to be achieved in the future whereas an intention is a way of being or living (Spiller, 2023).

Intentions require honesty with ourselves, and importantly, how we want to work, interact with others, or lead our lives. If the goal is a safe flight, how are we oriented to achieve that goal? Have I considered beforehand how I want to communicate with the other crewmembers? An intention could be to prioritize listening instead of speaking as others are trying to communicate. Have I taken time to understand their problem or question, or have I rushed to an assumption or solution? Have I considered how I want to handle distractions and balance priorities? The intention could be to recognize the specific moment when I have the desire to multitask. Have I considered how I tend to rush at various tasks, such as completing preflight duties or routine checklist items? An intention could be to recognize the pressure to rush throughout the duty day and to remind myself that deliberately slowing down decreases errors.

Breath Awareness as a Tool

The awareness of breath is a fundamental component of mindfulness training. While breath awareness is best practiced (and improved) in the framework of a regular, long-term habit, a developed practice can be used during everyday spontaneous situations that demand improved stress response or physiological reaction. As a result of stress, the body enters fight-or-flight response through activation of the sympathetic nervous system. Breathing then typically becomes more rapid, shallow, and originates from the upper chest. A developed awareness of this breath response provides an opportunity to counteract the stressor using the parasympathetic nervous system and return the body to a lower state of stress or anxiety.

Diaphragmatic or abdominal breathing uses a series of slow, deep breaths and can lead to a calmer state of mind. To initially learn this simple technique (Beer, 2023):

1. Sit or lie down in a comfortable position.
2. Place one hand on your chest and the other on your abdomen, below your rib cage.
3. Inhale slowly and deeply for several seconds through your nose, allowing the air to fill and expand your belly. Notice the hand on your belly being pushed outward.

4. To exhale, tighten your stomach muscles so that your lower hand moves back inward and allow the air to exit through your lips. Notice your hand moving inward and notice the sensations of the breath exiting your body.

Another common technique is called box breathing. While this is a distinct method from diaphragmatic breathing, these two methods can be combined for a complementary effect. To initially learn box breathing (Beer, 2023):

1. Sit in a comfortable position with your feet flat on the floor.
2. Bring awareness to your current breath cycles and start deepening these breaths.
3. Imagine a square, with each side representing one component of the breath cycle.
4. Inhale for about 4 seconds while imagining moving along one side of the square.
5. Hold the breath for about 4 seconds while imagining moving along the next side of the square.
6. Exhale for about 4 seconds while imagining moving along the next side of the square.
7. Hold your breath for about 4 seconds as you imagine moving along the last side of the square.
8. Repeat this cycle for a few minutes. Adjust the number of seconds to account for individual preference.

Another important method popularized by Dr. Andrew Huberman that can be used outside of formal meditation or breathwork sessions is the *double-inhale* (also referred to as *cyclic sighing* or the *physiological sigh*). In this simple technique, inhale through the nose until you reach nearly full capacity, and then take another shorter inhale to maximum capacity, followed by a long slow exhale through the mouth (the sigh). Research studies from Huberman and his team suggest active breathwork, particularly the double-inhale, were more effective at increasing positive mood than passive breath techniques, such as mindful meditation (Balban et al., 2023).

One systematic review of original clinical trials that evaluated the effectiveness of a variety of mindful breathing techniques on stress and anxiety identified several impactful guidelines to follow during implementation of a breathing practice (Bentley et al., 2023):

- Choose any practice that incorporates slow breathing (diaphragmatic, box breathing, etc.)
- For at least the first session, follow human-voice guidance (in person or audio/video)
- Be in a comfortable seated or lying position and in a location where you will not be interrupted
- Practice for at least 5 minutes
- Continue to practice often

These breathing practices all serve to calm the nervous system, improve blood flow to the brain, reduce anxiety, increase focus, and enhance cognition. While these breathing methods are often practiced in more formalized settings, they can be adapted for use as everyday tools in a variety of occupational settings, including aviation.

Achieving a Better Balance When Using Mobile Devices

Studies have indicated that distractions during flight operations are a significant and persistent safety threat. While this is not a new problem, the occurrence of mobile devices and internet connectivity in the flight deck have made the dangers of distraction even more prevalent. Unless prevented by setting personal limits, these distractions can occur at any time, including during preflight duties, taxiing, takeoff and landing, and any other high workload situations. Studies outside of aviation also show a strong relationship between technology use, cognitive workload, and distraction. Research performed on automobile drivers indicates that higher levels of automation increase task-switching between primary driving abilities and non-driving tasks, and this is directly associated with a higher crash risk (Ebel et al., 2023). Similar trends could occur in operating highly advanced aircraft. There have been several notable incidents and

accidents where PED usage (and its associated task-switching) during critical phases of flight were a contributing factor (*Crackdown on Distraction*, 2013). The FAA has issued an explicit prohibition against the personal use of electronic devices on the flight deck for Part 121 operators (*FAA InFO* 14006; *AC* 91.21-1D) and has encouraged other commercial operators to adopt a similar prohibition in their operations manuals. Despite these prohibitions personal use of PEDs is likely here to stay, however mindfulness practice offers several solutions to help pilots develop a better awareness of digital distraction and overuse of mobile technology.

Recommendations on how to critically analyze and improve PED usage include the following:

- Commit to exploring your own particular use of mobile phones and screen time. Do you have any personal limits on phone usage? Do these limits change during a duty day or while operating an aircraft? Do you ever wish you could decrease your reliance on your mobile phone?
- Notice your body's somatic response when using your phone. What is the physical response when you first pick up your phone? How does it feel after several minutes? Does your posture collapse forward? Does it cause eye strain? Does your breathing become shallower or more erratic? These effects are often unconscious. Bringing awareness back into the body will aid in reducing compulsive phone use, lowering tech-induced anxiety, improving focus, and reducing distractions.
- Review your notification settings. What causes your phone to produce an aural alert? Use *Do Not Disturb* or customized focus modes and make a default commitment to not allowing notifications from applications, especially sounds, unless specifically needed.

The Tactical Pause as a Means of Improving Sensemaking

One of the most challenging aspects of decision-making is balancing decision speed with accuracy. Research indicates that initiating a brief pause while making decisions can often improve the outcome. Not all situations in aviation allow for prolongation of the decision process of course, but there are important opportunities for this counterintuitive strategy throughout the ADM model. While the named concept of strategic pausing is unknown to many pilots, it has strong overlap with existing FAA ADM guidance and the associated decision models found in the *Pilot's Handbook of Aeronautical Knowledge* (3P, PAVE, CARE, TEAM). Loss of situational awareness can critically impair ADM and can be triggered by fatigue, stress, interruptions, inattention, poor mental models, and work overload. These insidious factors often cause pilots to fixate on a single perceived important item and lose a wider perspective. The tactical pause can often be implemented at each step of the *Perceive-Process-Perform* (3P) ADM framework:

1. *Perceive*. While gathering information about your situation, allow a pause as time allows, take a few deep breaths, look around, and see if your perspective widens. What else could you be missing?
2. *Process*. Pause, mentally step back and breathe, and consider your internal reactions as you evaluate the impact of risks and hazards identified during the *Perceive* stage. For example, if you said to yourself, "this will probably be ok" that is a clear signal to stop and investigate further. Is confirmation bias, plan continuation bias (*get-there-itis*), or expectation bias a possibility? Consider your assumptions. Would a simpler response be safer?
3. *Perform*. Before taking the best course of action, again allow a brief pause, take a few breaths as time allows, then move forward and evaluate its impacts.

While flying, there is often a predilection toward making decisions quickly (speed bias), but quick decisions made in complex situations often lead to mistakes. Giving your brain a moment to slow down allows it to process information, see patterns, and make novel connections (Nixon, 2025).

Mindful Listening and Speaking

Professional pilots work with a variety of people during a typical duty day and each individual plays an important role in getting an airplane safely into the air and back on the ground. Many of the problems in aviation human factors can be narrowed to problems in communication. Studies indicate only about 30% of a message is effectively understood during verbal communication. Furthermore, non-verbal cues are absent, and tonal clues are often attenuated or absent during radio communication. Lack of communication is listed as the top cause in the aviation industry's *Dirty Dozen* list of the most common human factors mistakes (Airbus, n.d.; FAA, n.d.).

How can we develop our communication skills? Mindful speaking and listening allows a buffer between impulse and response during verbal communication and offers the potential to improve clarity and comprehension, strengthen relationships, reduce unnecessary conflict, allow compromise, and improve our ability to see a situation objectively. These are important skills in any relationship, including those within CRM framework. While it is unrealistic to expect these to be used proficiently during every critical conversation, with practice and a personal commitment they can immediately begin to enhance your capacity to communicate effectively. Guidelines to practice *right listening* include the following:

- Commit to listening attentively first. This simple change in approach shifts the mind into a receptive stance.

- Pay attention to your own inner reactions as you listen but avoid getting hung up on a particular feeling. Take a few mindful breaths when your mind gets hung up on an issue.
- Listen with an open mind. Know that you can consider an idea without accepting or rejecting it. Rarely is a viewpoint entirely correct or incorrect.

Guidelines to practice *right speaking* include the following:

- Take a few breaths before responding.
- Is what I want to say factual?
- Is it necessary? Does it promote negativity or gossip?
- Is it timely? Is there a more effective time to discuss this?
- Is it unbiased?
- Ask open-ended questions. Advise when you do not understand something.
- Concisely sum up the other person's message and ask them if you understand it correctly.

Challenges to the Wider Implementation of Mindfulness Practice

Given the highly technical and regulatory nature of modern aviation, many training programs focus overwhelmingly on the "hard skills" associated with the direct operation of the aircraft, its equipment, and the dynamic operating environment. Nearly any accident report can be summarized by a breakdown of the human factors skills necessary for safe operation. Are these "soft skills" harder to transmit than technical skills? Is it because they are by nature less procedural? What makes these hazards so insidious? The mindfulness practices outlined in this document attempt to help bridge a gap between human factors theory and human factors application. There are, however, several criticisms and negative associations that limit broader acceptance. These include:

- Commercialization has reduced mindfulness practice to a trendy self-help technique.

- Mindfulness practice has been overpromoted as a universal remedy, despite mixed scientific evidence.
- Corporate-sponsored mindfulness programs are perceived as non-genuine and decontextualized and are seen as compliance to-do items.
- Problematic cultural associations, including socioeconomic, political, and racial dimensions, may discourage certain groups from engaging in mindfulness practice.
- The Westernization of mindfulness practice into a secular format has led to accusations of cultural appropriation as its religious and philosophical elements have been stripped away.
- An all-or-nothing mindset regarding these practices often exists and this can be discouraging in early adoption.

Conclusion

The successful adoption of secular mindfulness practice at an organizational level is currently tenuous because it is controversial and the methods generally do not fit within rote procedure. However, there are still many opportunities to include mindfulness practice in aviation human factors training and pilot development. These efforts must initially rely on building awareness of practical use applications in pilot well-being, mental health, communication, and decision-making and be clear in showing the realized benefit in professional development and throughout the aviation safety culture. The basic goals of any such effort need to be transparent and need to be clarified in advance. Critics should look at the implementation of other safety protocols that are now foundational, such as CRM, to see how early adoption of novel systems is often initially resisted before reaching commonplace acceptance. These practices will never be a complete solution, but they can play a key role in the next generation of aviation human factors development.

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Appendix A – Pilots' Perceptions of Mindfulness Survey Instrument

I am a certificated pilot (including student) and 18 years of age or older. *(SQ1)*

- Yes
- No

Choose your highest pilot certificate level (or military equivalent). *(SQ7)*

- Student
- Sport / recreational
- Private
- Commercial
- ATP

I have a CFI / CFII certificate. *(SQ8)*

- Yes
- No

What type of flying do you primarily perform? *(SQ11)*

- Airline
- Corporate/business
- Flight instruction
- Military
- Recreational
- Other

Select your approximate total number of flying hours. *(SQ9)*

- 0-100
- 101-500
- 501-1,000
- 1,001-3,000
- 3,001-5,000
- 5,001-10,000
- 10,001+

Have you ever intentionally practiced mindfulness in a <u>non-aviation</u> setting? *(SQ2)*

This could include meditation, body scan, mindful breathing/breathwork, digital detox, strategic/tactical pausing, single-tasking, mindful communication, mindful movement, yoga, and other techniques.

- Yes, occasionally
- Yes, regularly
- No

Before taking this survey, have you ever considered that mindfulness techniques could improve aviation human factors? *(SQ3)*

- Yes
- No

I believe that certain mindfulness techniques could be adapted to improve aviation human factors, and/or my capacities as a pilot or flight crewmember. *(SQ4)*

This could include meditation, body scan, mindful breathing/breathwork, digital detox, strategic/tactical pausing, single-tasking, mindful communication, mindful movement, yoga, and other techniques.

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

I often feel that current aviation human factors training leans too much on abstract theory and lacks relevant day-to-day operational practicality. *(SQ5)*

- Strongly disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Strongly agree

To what extent do you believe certain mindfulness techniques adapted for pilots could improve each of the following aspects of aviation? *(SQ10)*

Situational awareness
Aeronautical decision-making
Crew communication
Stress management
Quality of life
Fatigue management
Emotional regulation
Recognition of cognitive bias

- I don't know / No opinion
- Not at all useful
- Slightly useful
- Moderately useful
- Very useful

What do you believe is the greatest barrier to pilots using mindfulness techniques to improve their operational capacities? *(SQ12)*

- Lack of time
- Lack of awareness
- Skepticism
- Company or social culture
- Perception that mindfulness is unrelated to flying
- Lack of training
- Other

Is there anything else you would like to share about the use of mindfulness in aviation? *(SQ13)*

Appendix B – Open-Ended Responses

Appendix Table B. 1. Qualitative Analysis: Mindfulness and Aviation Human Factors

Participant Number	SQ13 **Is there anything else you would like to share about the use of mindfulness in aviation?**	SQ11 **What type of flying do you primarily perform?**	SQ7 **Choose your highest pilot certificate level (or military equivalent).**	SQ9 **Select your approximate total number of flying hours.**	**Codes**	**Themes**
P1	Many flight instructors teach mindfulness techniques, often without realizing it. I have used breathing techniques with students during stressful phases in their training help them reduce stress and find their rhythm. In the sense that mindfulness is consciously taking time to gain a better understanding of yourself and the world around you, it can be thought if as an extension of Situational Awareness.	Flight instruction	Commercial	1,001-3,000	Stress management, Situational awareness, Use in flight training, Breathing techniques, Existing operational use	Application, Performance, Well-being
P2	I am aware of other studies pioneering this area. The Indian Air Force seems to be advanced in this. It links to the use of breathing techniques already in use in some airlines as SOP for startle and surprise	Other	ATP	3,001-5,000	Breathing techniques, Existing operational use	Application, Performance
P3	As I see it mindfulness is typically considered a soft skill seen as something weak individuals hone whereas as a society I think we view the skills it takes to be a pilot as stronger that promote action before thought.	Recreational	Private	0-100	Cultural perception	Barriers
P4	FedEx did a mindfulness study back around 2018, I will see if I can get a copy and forward to the master's candidate.	Airline	ATP	5,001-10,000	Existing aviation research	Application
P5	I believe that the sterile flight deck tool is a type of mindfulness and is very useful and practical. Other methods of methodical usage of checklists procedures and checklists is another example of mindfulness. Other types should be explored if they can improve our level of safety and quality of life.	Airline	ATP	10,001+	Focus, Perceived usefulness, Existing operational use, QOL	Application, Performance, Well-being
P6	I don't think it has much of a place in aviation.	Flight instruction	Commercial	101-500	Limited perceived applicability	Barriers
P7	Consistent exercise and weight training could be very beneficial in aviation	Corporate/business	ATP	3,001-5,000	QOL	Performance, Well-being