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Conflict and Perceived Workload in Pilot–Controller Interactions

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TRAINING FOR SAFER SKIES: MITIGATING OPERATIONAL CONFLICT AND PERCEIVED WORKLOAD IN PILOT–CONTROLLER INTERACTIONS

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ABSTRACT

The interaction between pilots and Air Traffic Controllers (ATC) is essential for maintaining aviation safety. The increasing demands of air traffic management, the complexity of airspaces, and heightened operational constraints have shifted pilot-controller interactions from a purely technical process to a socio-technical context that imposes a substantial cognitive load. Although standard operational procedures and communication phraseology are fundamental to supporting these interactions, operational conflicts may still arise due to differences in perceived workload, time pressure, and situational awareness. This study examines the impact of technical training on reducing conflict levels and perceived workload in pilot-controller interactions. Drawing on human factors theory and the aviation safety literature, traditional training approaches that emphasize only technical competence are considered insufficient in complex operational environments. In contrast, training models that incorporate scenario-based simulations focused on workload awareness, communication competence, and cognitive processes are posited to enhance shared situational awareness and mutual understanding.

Communication significantly predicted conflict management ($\beta = 0.461$, $p < .001$). Training substantially reduced the negative effect of workload on perceived performance.

Keywords: Pilot–Controller Interaction; Perceived Workload; Conflict Management; Human Factors; Workload Management; Aviation Safety

1. INTRODUCTION

The increasing speed of global air traffic flow and the complexity of airspaces have increased the operational burden on pilots and air traffic controllers. Increased automation, coupled with factors such as traffic density and time pressure, has made aviation systems more modern and technical [1]. In this process, the human factor remains a fundamental element of safety, and the interaction between the pilot and the air traffic controller is one of the most critical steps in the system.

While aviation safety studies often focus on technical and procedural errors, accident investigations have shown that communication failures, cognitive overload, loss of situational awareness, and human-induced conflicts play a critical role in safety [2]. Despite standard terminology and training, the lack of complete alignment between pilot and air traffic controller decision-making processes leads to operational communication problems.

Perceived workload is a multidimensional concept encompassing cognitive, temporal, and psychological components, going beyond objective indicators such as task volume and traffic density [3]. In aviation, this perception impacts decision-making, communication, and error management. Differences in workload perception between pilots and air traffic controllers can lead to communication problems and mismatched expectations.

Time pressure, airspace restrictions, prioritization differences, and divergent situational interpretations are major causes of conflicts; if not managed effectively, coordination weakens and shared situational awareness deteriorates, therefore conflict prevention is critical in aviation safety management [4].

While traditional technical training programs focus on systems knowledge, procedural competence, and regulatory compliance, modern aviation safety approaches

also incorporate human factors, communication skills, and workload management [5]. Training that integrates pilots and air traffic controllers through shared scenarios and simulations has the potential to increase mutual understanding; however, academic studies on the impact of such training on conflict and perceived workload are limited.

This study combines human factors theory and aviation training literature by examining the impact of technical training on perceived workload and conflict dynamics in pilot-air traffic controller interactions [6]. It aims to identify shortcomings in current training programs and develop safety-focused training, offering practical contributions to aviation training institutions, service providers, and regulators.

Therefore, a training paradigm that explicitly emphasizes workload visibility, mutual calibration, and shared mental model alignment, rather than focusing exclusively on error prevention, constitutes a more effective safety intervention [7]. By addressing the underlying conditions that contribute to misinterpretation, this approach promotes the alignment of priorities, timing, and situational understanding, thereby reducing the risk of communication breakdown before it manifests operationally.

Unlike previous studies, which examine communication, workload or conflict separately, this study develops an integrated structural model explaining how communication, conflict management and perceived workload jointly affect perceived performance in pilot–air traffic controller interactions. Additionally, the study compares trained and untrained professionals to examine the buffering effect of training on workload-related performance degradation.

***Research Contributions**

This study makes four major contributions.

- It develops an integrated pilot–ATC interaction model.
- It investigates the mediating role of workload.
- It compares trained and untrained aviation professionals.
- It provides practical recommendations for aviation training organizations.

2. CONCEPTUAL AND THEORETICAL BACKGROUND

2.1. HUMAN FACTORS AND SAFETY APPROACHES IN AVIATION

Aviation systems are complex socio-technical structures, and safety depends on the reliability of the technical infrastructure and the quality of interaction between human performance [8]. The discipline of human factors aims to improve safety by examining the interactions between individuals, technology, tasks, and organizational structures.

Reason's "Swiss Cheese Model" shows that aviation accidents are often caused not by a single error, but by the simultaneous combination of weaknesses in multiple layers of defense. In this context, pilots and air traffic controllers are critical actors in the last line of defense of the system [9]. Communication errors, misperceptions, and cognitive overload can lead to the weakening of this line of defense. The SHELL model (Software, Hardware, Environment, Liveware) offers an important theoretical framework, especially for explaining pilot-controller interaction. In this model, the "Liveware–Liveware" interface, i.e., human-to-human interaction, is considered one of the most vulnerable areas in terms of safety. Communication between pilots and controllers is a direct reflection of this interface and depends on cognitive and social skills as well as technical competence.

A significant advancement in contemporary human factors analysis is the explicit integration of defensive-layer models with interaction-specific vulnerabilities. Within the Swiss Cheese framework, the pilot–controller interface functions as a critical defensive barrier, whose effectiveness relies on the alignment of intent, temporal coordination, and shared situational awareness. Concurrently, the SHELL model posits that the Liveware–Liveware interface is not merely a channel for information transmission but constitutes a dynamic process in which meaning is continuously negotiated amid uncertainty and limited cognitive resources. Thus, the integrity of this barrier is not predetermined; it arises from the quality of operational communication. Communication errors between pilots and air traffic controllers have been recognized as a significant safety concern in aviation, supporting the assertion that even routine exchanges may become operationally consequential when coordination deteriorates [10].

Accordingly, the safety of an operational state cannot be evaluated solely by its technical characteristics, as the same state may be rendered safe or unsafe depending on

whether the interface supports timely sensemaking and maintains common ground among participants. This consideration is particularly critical under high-workload conditions, where tolerance for ambiguity decreases, and minor deviations in phrasing, sequencing, or timing can result in significant coordination costs. Recent research demonstrates that communication-based markers serve as indicators of task demand and mental workload, reinforcing the argument that early signs of interface degradation should be regarded as operationally significant rather than incidental [11]. Therefore, training should not only address standardized phraseology but also foster the ability to identify early indicators of communicative brittleness, such as delayed readbacks, truncated transmissions, or diminished clarification behavior, and to implement compensatory strategies that restore shared situational awareness.

2.2. COMMUNICATION DYNAMICS BETWEEN PILOTS AND AIR TRAFFIC CONTROLLERS

Pilot–ATC communication is conducted under high time pressure, within a standardized language and procedures framework. While standard phraseology aims to reduce ambiguity in communication, contextual factors, expectations and mental models in the actual operational environment significantly affect the effectiveness of this communication [12]. Pilots and air traffic controllers evaluate the same operational situation from different perspectives. Pilots prioritize flight safety and aircraft performance from a cockpit perspective, while controllers consider the overall airspace, traffic flow, and separation standards [13]. These different perspectives can lead to communication breakdowns and misunderstandings when a shared situational awareness cannot be achieved. The concept of a "shared mental model" is a fundamental element of effective pilot-controller coordination; when weak, communication and operational harmony are negatively impacted because the parties cannot accurately predict intentions and limitations [14].

Pilot–controller communication can be enhanced by conceptualizing it as a shared cognitive task rather than a simple transmission channel. Effective exchanges occur not only when information is accurate, but also when each party can infer the other's operational logic, including what is being optimized (such as separation, sequencing, fuel efficiency, or stability), which constraints are binding (such as airspace, aircraft

performance, or standard flows), and which subsequent action is most probable. Misunderstandings frequently arise when both parties use the same terminology but hold different mental models of the situation, a problem closely tied to the quality of situation awareness in operational settings [15]. For example, a controller may interpret a delayed readback as reluctance or noncompliance, while the flight crew may be managing a workload spike due to configuration changes, terrain or weather considerations, or checklist actions. Conversely, a pilot may perceive a rapid sequence of instructions as undue pressure, whereas the controller may be implementing a necessary traffic resolution plan. Training that emphasizes explicit intent cues, such as brief rationale phrases where appropriate, proactive clarification norms, and calibrated pacing strategies can improve both message clarity and the predictability of behavior, which are essential components of shared situational awareness.

2.3. PERCEIVED WORKLOAD IN AVIATION OPERATIONS

Perceived workload is influenced by factors such as cognitive capacity, experience, stress, time pressure, and environmental conditions, and the perception of workload may vary among different pilots or controllers under the same operational conditions [16]. This directly impacts decision-making and communication in heavy traffic and anomalous situations.

Perceived workload mismatches between pilots and controllers lead to unrealistic mutual expectations, causing both parties to misjudge their capacities and limitations; this creates tension in communication and operational conflicts [17].

2.4. THE CONCEPT OF CONFLICT IN PILOT-AIR TRAFFIC CONTROLLER INTERACTIONS

In aviation, conflict arises as a natural consequence of intra-system interactions rather than interpersonal problems. Differences in operational priorities, time pressure, and differing situational interpretations trigger conflicts between pilots and controllers [13]. These conflicts are examined in three main categories: communicative (misunderstanding, incomplete information), perceptual (different risk assessments), and operational (airspace restrictions, traffic congestion, procedural limitations).

Ineffectively managed conflicts erode mutual trust, negatively impact shared situational awareness and team performance; therefore, conflict prevention and reduction require systematic training and organizational approaches as well as individual skills [18].

2.5. THE IMPORTANCE OF THE THEORETICAL FRAMEWORK IN TECHNICAL TRAINING

Technical training is an indispensable element of aviation safety, but it cannot adequately address human factors risks when it is limited to procedural knowledge transfer [19]. Current theoretical approaches require the integration of technical training with human factors, communication and workload management.

This study aims to present a holistic theoretical framework examining how perceived workload and conflict in pilot-controller interactions can be reduced through technical training [20]. By considering human factors theory, the common mental model approach and the workload perception literature together, training-based safety improvement strategies are created.

3. ROLE OF TECHNICAL TRAINING IN AVIATION SAFETY

3.1. DISTINCTION BETWEEN TECHNICAL AND NON-TECHNICAL SKILLS

Aviation training systems have historically focused on developing technical competencies. In this context, knowledge of aircraft systems, air traffic procedures, regulatory knowledge and operational standards form the basis of technical skills [21]. While technical skills are an indispensable component of safe operations, the increasing complexity of modern aviation systems reveals that these skills alone are not sufficient.

Non-technical skills encompass cognitive and social competencies such as communication, teamwork, situational awareness, decision-making, and workload management; Crew Resource Management (CRM) and Threat and Error Management (TEM) approaches highlight the critical role of these skills in aviation safety and create an integrated framework with technical skills [21].

3.2. GAPS IN CURRENT PILOT AND AIR TRAFFIC CONTROLLER TRAINING PROGRAMS

Pilot and ATC training programs, despite being subject to high standards and strict regulations, have certain limitations in terms of human factors integration [5] Much of the training focuses on evaluating individual performance; pilot-controller interaction is often addressed indirectly or through limited scenarios.

In current training models, pilots and controllers are usually trained in separate training environments, developing limited awareness of the operational constraints and workload dynamics of the other side. This can create a disconnect between operational reality and the training environment [5]. Communication problems, especially those arising under heavy traffic, abnormal situations and time pressure, are not sufficiently experienced during the training process.

In addition, the fact that technical trainings are largely procedure-oriented means that subjective but safety-critical variables such as perceived workload and conflict are relegated to secondary importance [5]. This situation can lead to the fact that human factor-related risks arising in the operational field cannot be adequately reduced through training.

3.3. INTEGRATION OF HUMAN FACTORS INTO TECHNICAL TRAINING

Current aviation safety approaches consider the integration of human factors into technical training as a strategic requirement. Technical knowledge and procedural competence may have a limited impact on safety when considered without taking into account the limitations of human performance and cognitive processes [22].

Human factors integration includes perceived workload awareness, stress management, communication strategies, and mutual expectation management [23]. Pilots and controllers being sensitive not only to their own tasks but also to the cognitive and operational load of the other party contributes to the development of shared situational awareness. This approach creates a more collaborative operational environment by reducing the potential for conflict.

Supporting technical training with scenario-based simulations stands out as one of the most effective ways to integrate human factors [24]. Realistic operational scenarios

improve not only the technical skills of the participants but also their communication, decision-making and workload management competencies.

4. MITIGATING CONFLICT THROUGH TRAINING INTERVENTIONS

4.1. COMMUNICATION-FOCUSED TECHNICAL TRAINING APPROACHES

A significant portion of the conflicts that arise in pilot-air traffic controller interactions stem from ambiguities in communication and mismatches in mutual expectations [25]. Although standard phraseology aims to create a common language in communication, operational context, tone, timing, and the way the message is perceived directly affect the effectiveness of communication. Therefore, communication-focused technical training plays an important role in training interventions aimed at reducing conflict.

Communication-focused technical training should include not only the use of correct expressions but also an understanding of the cognitive impact of the message on the other party. Pilots and controllers should consider the other party's current workload, time pressure, and operational priorities during communication to reduce the potential for conflict. This approach ensures that communication ceases to be a one-way transfer of information and becomes a process of mutual coordination [26].

In addition, analyzing communication errors derived from real operations in trainings allows participants to learn through concrete experiences rather than abstract rules [27]. Such practices support the early recognition and prevention of communication-related conflicts.

4.2. PERCEIVED WORKLOAD AWARENESS AND MANAGEMENT

Perceived workload stands out as a significant determinant of conflict in pilot-controller interactions. If one party perceives the other party's workload as lower or higher than it actually is, this can lead to tension in communication and operational inconsistencies [28]. Therefore, in training interventions aimed at reducing conflict, improving awareness of perceived workload should be considered a fundamental goal.

Workload awareness training aims to help pilots and controllers recognize their own cognitive limitations as well as understand the capabilities and limitations of the other party [29]. In this context, it should be demonstrated experientially how the

workload changes under heavy traffic, time pressure and abnormal situation scenarios. In this way, participants can evaluate the impact of operational decisions and communication demands on the other party more realistically.

Balancing perceived workload strengthens the preventive dimension of conflict management. This awareness, developed through training, contributes to the parties adopting a more flexible, understanding and cooperative communication style [30].

4.3. SCENARIO AND SIMULATION-BASED TRAINING INTERVENTIONS

Simulation-based training is considered one of the most effective intervention tools for conflict reduction. Simulations with a high level of realism allow participants to simultaneously improve both their technical skills and their communication and workload management competencies [31].

Simulation applications in which pilots and controllers participate together in the same scenario offer the opportunity to experience real operational interactions in a safe learning environment [5]. Such trainings allow the parties to directly observe each other's decision-making processes, priorities and cognitive loads. Thus, potential points of conflict can be identified and managed before they are reflected in real operations.

In particular, unexpected situations, scenarios involving heavy traffic and time constraints represent the conditions in which conflict dynamics are most clearly revealed. These training scenarios improve participants' communication and coordination skills under stress [32].

5. MATERIALS AND METHODS

5.1 POPULATION AND SAMPLE

The study population consisted of licensed pilots and active air traffic controllers working in commercial airline operations, and a diversified sample with participants of varying experience levels was selected on a voluntary basis.

The pilot group consists of captains and co-pilots who operate narrow-body and wide-body aircraft, while the air traffic controller group comprises personnel involved in approach, tower, and area control services.

To compare continuous variables within groups, a minimum sample size of 176 was determined using G*Power 3.1.9.4 software with a moderate effect size (d=0.5), 95% confidence level, and 95% power ratio. Due to potential data loss, this number was increased by 20% to include 211 cases in the study.

5.2 RESEARCH DESIGN AND SCOPE

This study is a cross-sectional and observational research conducted as part of a doctoral thesis, examining the effects of technical training on perceived workload and conflict in interactions between pilots and air traffic controllers.

The research was conducted using an online survey-based data collection method, administered to participants via Google Forms. Within the scope of the study, volunteer pilots and air traffic controllers were reached through the researcher's personal communication networks (email, WhatsApp, professional social networks, etc.) and the survey link was shared through organizations such as Pilots Foundation (PILVAK) and Air Traffic Controllers Association (TATCA). Participation in the study was voluntary, and participants proceeded with the survey by completing the online consent form.

The researcher administered a survey based on a literature review to the participants. Two separate questionnaire forms were created for pilots and ATC personnel. The questionnaire form administered to pilots consists of a total of 26 questions: 5 questions in section 1 - Demographic Information, 9 questions in section 2 - Perception of Communication and Teamwork, 6 questions in section 3 - Conflict Perception and Management, and 6 questions in section 4 - Workload Perception. The questionnaire form is given in Appendix 1A.

The questionnaire form administered to ATCs consists of a total of 24 questions: 5 questions in section 1 - Demographic Information, 8 questions in section 2 - Perception of Communication and Teamwork, 6 questions in section 3 - Conflict Perception and Management, and 5 questions in section 4 - Workload Perception. The survey form is

provided in Appendix 2A. For each question in the survey, participants evaluated using the options "Strongly disagree," "Disagree," "Neutral," "Agree," and "Strongly agree."

Methodological transparency is strengthened by providing explicit justification for how the survey captures the subjective mechanisms central to the research question. Given that perceived workload and conflict are experience-based constructs, the use of self-report instruments is appropriate. Interpretability increases when the manuscript specifies the operational context respondents should consider, such as routine operations, peak traffic, or abnormal scenarios; the reference timeframe, such as the previous six months; and the operationalization of training exposure, including type, recency, intensity, and whether it involved joint pilot and air traffic control scenarios. As the sample comprises two professional groups, the analysis would be improved by a brief statement on measurement equivalence, confirming that the core constructs communication and teamwork, conflict management, workload perception, and perceived effectiveness hold comparable meaning for both pilots and controllers. If multi-group analysis is not feasible, the manuscript should acknowledge this as a design consideration and describe the steps taken to minimize interpretive drift, such as parallel item wording, pilot testing, and alignment of response anchors.

5.3 METHOD OF THE RESEARCH

There are many methods can be implemented to reduce the lack of communication between pilots and air traffic control personnel.

5.3.1 Online Platforms

Online platforms use data analytics and artificial intelligence to deliver personalized learning experiences; they analyze individual performance, identify areas for improvement, and provide tailored training recommendations and resources for each student [33]. This approach focuses on the needs of pilots and air traffic control personnel, enabling them to enhance their skills and deepen their knowledge.

These online platforms track students' progress, providing valuable insights into their development, and encourage continuous professional growth by awarding

certificates or digital badges to those who complete various training modules, documenting their achievement [34].

5.3.2. Partnership Programs with Educational Institutions

Partnerships with reputable educational institutions and universities offer specialist courses and prestigious advanced certifications to pilots and air traffic control personnel. Through these collaborations, professionals gain in-depth knowledge in niche areas such as aviation safety management or advanced air traffic control systems [35]. Specialized programs provide comprehensive training covering the complexities of the aviation industry, equipping individuals with the advanced knowledge and practical skills necessary to succeed in their roles.

5.3.3. In Company Trainings

Establishing a culture of continuous professional development is crucial in aviation organizations. Encouraging employees to set personal development goals, allocating time for learning, and rewarding achievements creates a proactive learning environment [36]. This approach not only benefits individuals but also contributes to the growth and success of the aviation industry.

5.3.4. Virtual Reality (VR) and Augmented Reality (AR) Technologies

Partnerships with prestigious educational institutions and universities offer pilots and air traffic control personnel specialized courses and reputable advanced certifications. Through these partnerships, professionals can develop their skills in niche areas such as aviation safety management or advanced air traffic control systems [37]. Meticulously designed programs provide in-depth insights into the complex dynamics of the aviation industry, equipping participants with the advanced knowledge and practical skills necessary to succeed in this rapidly changing sector.

5.3.5. Implementation of the Mentorship Programs

Collaborations with prestigious educational institutions and universities offer pilots and air traffic control personnel specialized courses and reputable advanced certifications. Through these partnerships, professionals can specialize in niche areas such as aviation safety management or advanced air traffic control systems. Meticulously designed programs provide an in-depth understanding of the complex dynamics of the

aviation industry and equip individuals with the advanced knowledge and practical skills necessary to succeed in critical roles in this rapidly changing sector [38].

5.3.6. Industry Conferences and Workshops

Continuous professional development is supported through industry conferences and workshops; these events bring together experts and professionals in the aviation sector, providing opportunities for networking, knowledge sharing, and skill development [39]. Participants stay informed about current developments, expand their knowledge, and contribute to the continuous advancement of the sector through informative sessions, panel discussions, and hands-on workshop.

5.3.7. Mentoring Programs

Mentoring programs are a vital tool for supporting continuous professional development in the aviation industry. Matching experienced professionals with newcomers facilitates the transfer of knowledge, skills, and best practices. Mentors contribute to mentees' career growth and success by offering guidance [40] These dynamic fosters a learning culture, providing aviation professionals with the necessary support and guidance for continuous self-improvement.

5.4. DATA ANALYSIS

Before testing the research hypotheses, validity and reliability analyses of the measurement model were conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM). The evaluation included assessments of internal consistency reliability, convergent validity, discriminant validity, and multicollinearity to ensure the model's robustness and accuracy.

5.4.1 Evaluation of the Measurement Model

The perceived communication and teamwork (COM) variable were modeled as a single dimension using a second-order approach. Reliability was assessed through Cronbach's Alpha and composite reliability (CR), while convergent validity was evaluated by examining factor loadings and average variance extracted (AVE) values, ensuring the measurement model's robustness.

The measurement model demonstrates strong validity and reliability, meeting established threshold criteria from the literature. Factor loadings range from 0.796 to 0.927, exceeding the 0.70 benchmark and indicating strong indicator representation of constructs. Internal consistency is confirmed by Cronbach's Alpha values between 0.796 and 0.886, and composite reliability values from 0.894 to 0.929, both above the 0.70 threshold. Additionally, average variance extracted (AVE) values range from 0.677 to 0.830, surpassing the 0.50 criterion and confirming convergent validity. Overall, these results indicate a robust measurement model with high reliability and validity.

5.4.2 Discriminant Validity

Discriminant validity was assessed using the heterotrait–monotrait ratio (HTMT) and the Fornell–Larcker criterion, both standard methods in PLS-SEM studies, with particular emphasis on the HTMT approach proposed by Christian Henseler et al.

The HTMT matrix analysis shows all values below the 0.85 threshold, indicating adequate discriminant validity among the constructs in the research model. No multicollinearity problems were detected, supporting the robustness of the structural model.

The Fornell–Larcker criterion reveals that each variable's average variance extracted (AVE) root exceeds its correlations with other variables, confirming that the measurement model achieves discriminant validity and effectively distinguishes between constructs.

5.4.3 Multicollinearity Analysis

To assess multicollinearity in the research model, Variance Inflation Factor (VIF) values were analyzed, with values below 5 indicating no multicollinearity issue according to established literature.

The analysis showed VIF values ranging from 1.000 to 3.161, all below the critical threshold, indicating that the model does not suffer from multicollinearity issues.

5.5. ETHICAL APPROVAL

The study was reviewed and approved by the Cyprus International University Scientific Research and Publication Ethics Committee during the meeting held on October 21, 2025 (Decision No: EKK25-26/02/01). All participants provided informed consent before completing the questionnaire. All methods were carried out in accordance with relevant guidelines and regulations, including the ethical principles outlined in the Declaration of Helsinki.

5.6. HYPOTHESIS DEVELOPMENT

Aviation systems are socio-technical structures characterized by high complexity, intense time pressure, and low fault tolerance. Interactions between pilots and air traffic controllers play a critical role in flight safety [41]. The literature emphasizes that the quality of these interactions affects perceived workload and performance through human factors such as conflict management, communication, and teamwork.

5.6.1. The Relationship Between Communication and Teamwork and Conflict Management

Effective communication and strong teamwork in operational interactions between pilots and air traffic controllers are key human factors that support the constructive handling of emerging disagreements. The literature reports that open and

standardized communication strengthens intra-team trust and mutual understanding, preventing conflicts from escalating; and that teamwork enhances coordination, supporting conflict management skills [42]. Accordingly, it is assumed that the level of communication and teamwork positively and significantly influences conflict management.

H1: *The level of communication and teamwork has a positive and significant impact on conflict management.*

5.6.2. The Relationship Between Communication and Teamwork and Perceived Workload

Effective communication and teamwork are considered essential elements in maintaining situational awareness and ensuring task coordination in aviation operations [43]. Ensuring clear, timely and standardized communication between pilots and air traffic controllers contributes to reducing uncertainty and balancing cognitive load.

H2: *The level of communication and teamwork has a negative and significant effect on perceived workload.*

5.6.3. The Relationship Between Conflict Management and Perceived Performance

Effective conflict management contributes to maintaining task orientation in operational processes and strengthening team trust. In high-risk environments such as aviation, constructive conflict management approaches are said to positively affect individual and team performance [44].

H3: *Conflict management skills have a positive and significant impact on perceived performance.*

5.6.4. The Relationship Between Perceived Workload and Perceived Performance

Perceived workload refers to the subjective assessment of the extent to which individuals can meet the demands of their tasks with their current cognitive and

physical capacities [43]. In aviation literature, it is stated that increased perceived workload negatively affects decision-making processes, increases the probability of errors and is associated with decreased performance.

H4: *Perceived workload has a negative and significant effect on perceived performance.*

5.6.5. The Relationship Between Communication and Teamwork and Perceived Performance

Effective communication and coordination between pilots and air traffic controllers are critical to improving mission success by reducing operational errors. Strong teamwork environments enhance individuals' perception of their performance and confidence in mission outcomes [45].

H5: *The level of communication and teamwork has a positive and significant impact on perceived performance.*

5.7. RESEARCH MODEL

This research model was developed to examine the effects of human factors-focused technical training on perceived workload and perceived performance in pilot-air traffic controller interactions. In the research model, conflict management, communication, and teamwork were considered as independent variables; perceived workload was defined as the mediating variable, and perceived performance as the dependent variable.

The research model is shown in Figure 1.

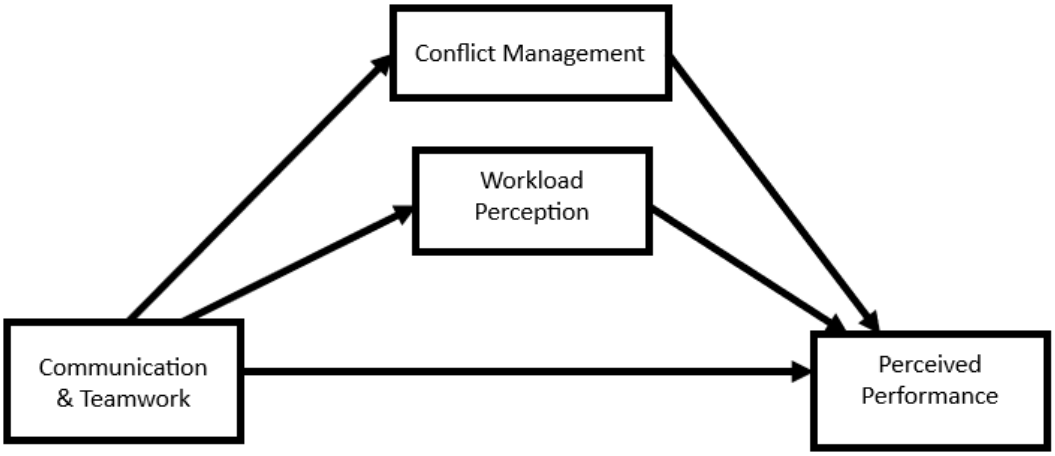


Figure 1. The research model was developed based on a literature review to support the hypothesis.

The model addresses the communication-workload-performance relationship highlighted in the human factor's literature within a holistic framework and assumes that conflict management, communication, and teamwork have both direct and indirect effects on perceived performance.

6. FINDINGS

The structural patterns indicate that the pathway from communication to performance is complex and operates primarily through intermediate human factors. In the control model, communication and teamwork are strongly associated with both conflict management and workload perception, while workload demonstrates a pronounced negative association with perceived effectiveness. This configuration aligns with an operational logic in which communication quality influences coordination demands and cognitive burden, and performance judgments reflect the perceived manageability of total workload during operations. In the experimental or training model, the negative association between workload and perceived effectiveness diminishes and becomes non-significant, whereas the conflict-management pathway exhibits a stronger positive relationship with perceived effectiveness. This pattern is significant because it indicates that training may not simply reduce workload, but may alter how individuals cope with,

interpret, and regulate workload pressures, thereby enhancing performance resilience even when operational demands remain high, a finding consistent with contemporary workload–performance frameworks in human factors research [46].

Descriptive statistics

In the study, 55% of the 211 participants were pilots and 45% were air traffic controllers (ATC). Regarding gender distribution, 79.1% (n=167) were male and 20.4% (n=43) were female. In terms of marital status, 73.5% (n=155) were married and 26.5% (n=56) were single.

Regarding educational level, the majority of participants held bachelor's degrees (68.2%; n=144). This was followed by master's degree holders (25.1%) (n=53), while the percentages of high school graduates (3.3%; n=7) and doctoral degree holders (3.3%; n=7) were lower. Examining professional experience, 37.0% (n=78) of participants had 16 years or more of experience, 28.0% (n=59) had 6–10 years, 21.3% (n=45) had 11–15 years, and 13.7% (n=29) had 0–5 years of experience. The socio-demographic characteristics of the participants are presented in Table 1.

Table 1: Socio-demographic characteristics of the participants

		Frequency	**Percent**
Field	Pilot	116	55.0 %
	ATC	95	45.0 %
Gender	Female	43	20.4 %
	Male	167	79.1 %
Marital Status	Single	56	26.5 %
	Married	155	73.5 %
Education Level	High School	7	3.3 %
	Bachelor Degree	144	68.2 %
	Master Degree	53	25.1 %
	PhD	7	3.3 %
Experience	0-5 years	29	13.7 %
	6-10 years	59	28.0 %
	11-15 years	45	21.3 %
	16 and above	78	37.0 %

Before conducting the analysis of the research model, tests for validity and reliability were performed on the constructs used in the study. To simplify the analysis, the positive organizational climate variable was modeled as a single dimension using second-order modeling. Validity and reliability assessment included examining internal consistency, convergent validity, and discriminant validity. Internal consistency was assessed using Cronbach's Alpha and composite reliability (CR), while convergent validity was assessed using factor loadings and mean-variance inference (AVE). Acceptable results required factor loadings ≥0.70, Cronbach's Alpha and CR coefficients ≥0.70, and AVE values >0.50 [47], [48]. The results obtained according to these criteria are detailed in Table 2.

According to Hair et al., items with factor loadings below 0.40 should be removed from the measurement model; items between 0.40 and 0.70 should only be removed if the AVE or CR values of the relevant variable fall below the threshold [48].

Table 2: Measurement Model Results

Variable	Item	Factor Loadings	C's alpha	CR	AVE
Perceived Communication and Teamwork	**COM1**	0.827	0.841	0.894	0.677
	COM2	0.835			
	COM3	0.834			
	COM4	0.796			
Conflict Perception and Management	**CFL1**	0.894	0.886	0.929	0.814
	CFL2	0.927			
	CFL3	0.885			
Workload Perception	**WLP1**	0.897	0.796	0.907	0.83
	WLP2	0.924			
Perceived Effectiveness	**PEPE**	1.000	.	.	.

The heterotrate-monotrate ratio (HTMT) criterion was used to evaluate the discriminant validity of the measurement model [49]. The HTMT coefficients in Table 3 are below the threshold of 0.85, indicating that discriminant validity is established between the constructs in the measurement model.

Table 3: Discriminant Validity – HTMT Matrix

	CFL	COM	PEPE	WLP
CFL				
COM	0.506			
PEPE	0.224	0.073		
WLP	0.185	0.397	0.207	

Table 4: Discriminant Validity – Fornell-Larcker Criterion

	CFL	COM	PEPE	WLP
CFL	**0.902**			
COM	0.438	**0.823**		
PEPE	0.215	0.058	**1.000**	
WLP	0.153	0.330	-0.182	**0.911**

According to Hair et al. (2022), Variance Inflation Factor (VIF) values below 5 do not indicate a multicollinearity problem; all VIF coefficients in Table 5 remained below this threshold [48]. This study concluded that the variables used did not exhibit multicollinearity.

Table 5: Collinearity Statistics

	VIF
CFL1	2.760
CFL2	3.161
CFL3	2.164
COM1	1.909
COM2	1.912
COM3	1.958
COM4	1.723
PEPE	1.000
WLP1	1.776
WLP2	1.776

Figure 2: Structural Model 1: Control Group

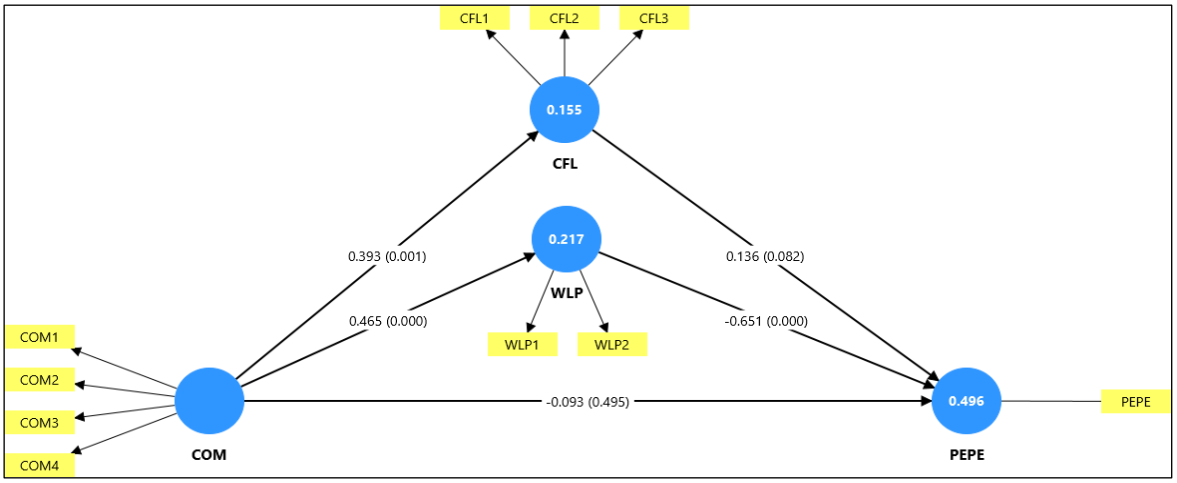


Table 6: Model 1 Path Coefficients

	Original sample (O)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	CI 2.5%	CI 97.5%
CFL -> PEPE	0.136	0.078	1.738	0.082	-0.002	0.310
COM -> CFL	0.393	0.115	3.411	0.001*	0.129	0.594
COM -> PEPE	-0.093	0.136	0.682	0.495	-0.37	0.171
COM -> WLP	0.465	0.131	3.550	0.000*	0.199	0.698
WLP -> PEPE	-0.651	0.123	5.295	0.000*	-0.834	-0.327
COM -> CFL -> PEPE	0.054	0.041	1.296	0.195	-0.008	0.155
COM -> WLP -> PEPE	-0.303	0.102	2.957	0.003*	-0.534	-0.132

No statistically significant relationship was found between communication and teamwork skills and perceived performance (p = 0.082).

A statistically significant difference was found between communication and teamwork skills and conflict management (p = 0.001), indicating that communication has a significant impact on conflict management. No statistically significant difference was

found between perceived performance and conflict management (p = 0.495); therefore, it was concluded that conflict management does not have a significant effect on perceived performance.

A statistically significant difference was found between conflict management and workload perception (p = 0.000). This finding reveals that conflict management has a significant impact on workload perception. Furthermore, when comparing workload perception with performance perception, a statistically significant difference was found (p = 0.000), and it was observed that the group with a high workload perception had a lower performance perception. This result shows that workload perception has a negative and strong impact on performance perception.

Figure 3: Structural Model 2: Experimental Group

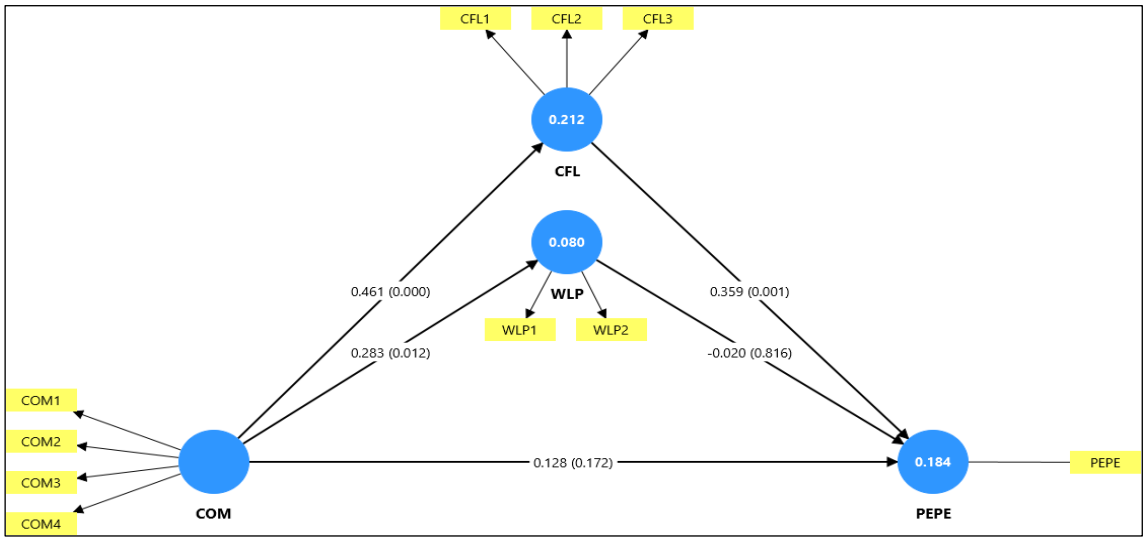


Table 7: Model 2 Path Coefficients

	Original sample (O)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	CI 2.5%	CI 97.5%
CFL -> PEPE	0.359	0.112	3.214	0.001*	0.120	0.556
COM -> CFL	0.461	0.097	4.764	0.000*	0.261	0.640
COM -> PEPE	0.128	0.094	1.365	0.172	-0.041	0.327

COM -> WLP	0.283	0.113	2.507	0.012*	0.061	0.495
WLP -> PEPE	-0.020	0.087	0.233	0.816	-0.180	0.157
COM -> CFL -> PEPE	0.166	0.058	2.837	0.005*	0.055	0.285
COM -> WLP -> PEPE	-0.006	0.027	0.213	0.831	-0.060	0.050

The mediation analysis findings indicate that the direct effect of perceived workload (WLP) on perceived performance (PEPE) weakens and loses statistical significance among individuals who receive training in conflict management. On the other hand, the effect of conflict management on perceived performance was found to be statistically significant.

The analysis results revealed that the training significantly increased the level of conflict management. Furthermore, including the training variable in the model had a mitigating effect on the negative impact created by perceived workload.

7.DISCUSSION

A plausible interpretation of the observed model differences is that training functions as a cognitive buffer, enhancing coordination quality under pressure. In high-tempo aviation environments, workload is shaped not only by task quantity but also by uncertainty, anticipation demands, and the coordination required to manage competing priorities. Conflict management training may reduce the cognitive cost of disagreement by introducing structured strategies for rapid alignment, including direct clarification, constructive compromise, and controlled escalation. These strategies can prevent coordination failures from consuming additional mental resources. This mechanism may

explain the strong negative association between workload and perceived effectiveness in the absence of training, as well as the reduced association when conflict management competence is present. Consequently, training may enable a shift from workload-reactive to workload-aware operations, supporting a more stable shared mental model even when time pressure and traffic complexity remain constant.

The fact that communication's effect on perceived performance was not found to be statistically significant in this study indicates that performance perception is a multidimensional construct and cannot be explained solely by the communication variable [50]. While the literature states that effective communication is related to team performance and organizational outcomes, this finding suggests that communication alone may not play a decisive role in perceived performance. The fact that employee performance is largely measured based on subjective evaluations leads to a stronger influence of psychosocial factors such as individual motivation, leadership style, perceived organizational support, and job demands on performance [51]. The literature shows that the impact of communication on performance is generally indirect, and that the quality of communication influences team and project performance through processes such as team trust, coordination, behavioral integration, and psychological safety [52].

The findings indicate that communication alone is insufficient to explain perceived performance; future studies should examine the relationship between communication and performance using structural models that include mediating and moderating variables. Research findings indicate that effective communication, a key determinant of safe operations in the aviation industry, plays a critical role in managing operational disagreements and task-based conflicts, thus having a significant impact on conflict management [53]. Research findings indicate that effective communication, a key determinant of safe operations in the aviation industry, plays a critical role in managing operational disagreements and task-based conflicts, thus having a significant impact on conflict management [54]. CRM approach enables the constructive management of operational tensions through effective communication and coordination [55]. The perceived impact of conflict management on performance stems from the fact that in aviation, performance is more dependent on technical proficiency, adherence to

procedures, and successful task completion; performance, in turn, is shaped by standard operating procedures, situational awareness, and workload management [53].

While effective conflict management is important for operational safety, it may not directly affect individuals' perceptions of performance; conversely, the human factors literature indicates that workload and cognitive demands have strong and direct impacts on performance [56].

This situation demonstrates that conflict management affects performance through indirect mechanisms.

This study demonstrates that communication between pilots and air traffic controllers plays a critical role in strengthening conflict management. However, it was found that conflict management alone is insufficient to directly explain perceived performance. This suggests that performance perception in the aviation environment exhibits a multidimensional structure. Therefore, it is recommended that future research examine communication, workload, and other human factors within the framework of holistic models.

Research findings indicate that conflict management significantly affects perceived workload. This suggests that effectively managing interpersonal tensions and operational conflicts in aviation operations can reduce perceived workload [57]. Since interactions between pilots and air traffic controllers occur under high time pressure and cognitive demands, constructively addressing conflicts can play a role in reducing task complexity and mental burden.

Empirical and theoretical studies in the field of human factors reveal that both task-related ambiguities, such as goal and role uncertainties, and interpersonal conflicts and tensions are key factors that increase cognitive overload and mental workload [58].

However, the finding that perceived workload has a strong negative impact on perceived performance is consistent with studies in aviation that have demonstrated an inverse relationship between mental workload and performance. Specifically, high mental workload can lead to decreased situational awareness, slowed decision-making processes, and increased probability of error in pilots and air traffic controllers [59]. For example, it has been shown that under increasing task complexity and workload, both pilots and

ATCs experience decreased situational awareness levels, which is associated with erroneous decisions and impaired performance.

Similarly, high mental workload in flight simulations and real operational environments has been associated with increased reaction times, decreased information integration capacity, impaired time perception and decreased accuracy in anomaly detection [60].

These findings suggest that increased perceived workload leads individuals to evaluate their own performance more negatively and significantly reduces their subjective performance perception [61].

This study demonstrates that conflict management significantly reduces perceived workload, and that workload perception negatively impacts performance perception. Effective conflict management contributes to improved performance by reducing cognitive workload among pilots and air traffic controllers.

Research findings indicate that adding variables such as conflict management or training to the model reduces the impact of perceived workload on perceived performance and eliminates its significance. This reveals that performance in aviation operations cannot be explained solely by workload; the literature emphasizes that the negative effects of high mental workload are shaped by contextual and organizational factors [62].

Studies show that high mental workload reduces the performance of air traffic controllers, but awareness and social service support significantly mitigate these negative effects [63].

Pilots' decision-making performance varies depending on workload as well as individual and educational factors such as flight experience, level of cognitive thinking and type of training received [60].

In complex air combat scenarios, a pilot's tactical target awareness is crucial. The relationship between mental workload and performance can be misinterpreted. Low workload and poor performance may stem from a lack of awareness of mission objectives [64].

These findings suggest that workload indicators should be considered alongside variables such as training, organizational support, conflict management, and task awareness when evaluating perceived performance in aviation [65].

The study shows that conflict management has a significant impact on perceived performance and that constructive conflict management can improve both individual and organizational performance [66].

In a corporate context, effective conflict management improves employee performance and service quality by increasing collaboration and trust, while poorly managed conflicts lead to stress and loss of productivity [67].

The findings also show that training interventions play a critical role in this process. In particular, training focused on conflict management and CRM is reported to improve employees' conflict resolution skills, communication, and mutual trust; consequently, both the frequency and intensity of conflict decrease, and performance indicators improve [17].

Intervention studies conducted in aviation and other high-stress sectors have shown that conflict management or time/resistance management training reduces levels of role conflict, burnout, violence, and complaints; lowers absenteeism and requests for third-party mediation; and thus, positively impacts both well-being and organizational outcomes [68].

In this context, it can be said that the training activities in the present study have a twofold function: on the one hand, they increase perceived performance by enabling employees to apply conflict management more effectively, and on the other hand, they function as a buffer mechanism to dampen the negative impact of perceived workload (WLP) on performance [69]. The literature also indicates that the negative effects of stressors such as workload and emotional demands on performance and burnout are reduced in the presence of effective conflict strategies and social/organizational support mechanisms; in other words, conflict management and related skills training can play a moderating role in this relationship.

These findings indicate that performance perception in aviation operations should be considered not only in terms of workload level, but also in conjunction with conflict management capacity, a climate of trust, and systematic training programs in these areas.

8. CONCLUSION

The study examined the impact of technical training on the perception of conflict and workload between pilots and air traffic controllers, demonstrating that training is a strategic aviation safety element that improves communication quality, reduces human-factor risks, and lowers cognitive load.

Research findings indicate that scenario-based training fosters the development of shared mental models in pilot-air traffic controller interactions, contributing to more harmonious decision-making, reduced communication ambiguities, and clarified task prioritization. Furthermore, it has been shown that reduced perceived workload indirectly lowers conflict levels, demonstrating a systemic impact of technical training.

The study emphasizes that aviation safety can be sustainably enhanced not only through technological advancements but also through training strategies that focus on human factors. Integrating modules, scenario and simulation applications into pilot and air traffic controller training, and integrating training outcomes with Safety Management Systems (SMS) are seen as significant steps in improving operational safety.

Technical training improves safety performance and balances perceived workload by reducing conflict in pilot-air traffic controller interactions. Interdisciplinary, holistic training approaches in complex aviation systems are a strategic requirement for safer airspace. These findings provide evidence that joint pilot–ATC training should become an integral component of aviation safety management systems.

9. PRACTICAL IMPLICATIONS FOR AVIATION TRAINING ORGANIZATIONS

This research highlights the critical role of interactions between pilots and air traffic controllers in aviation training for safety. It suggests that training programs should focus not only on technical competencies but also on cognitive and behavioral dimensions such as human factors, perceived workload, and conflict management.

It is recommended that educational institutions structure their programs for pilots and air traffic controllers into standardized modules around common terminology, procedural expectations and operational priorities; this approach prevents communication errors and misunderstandings by establishing shared mental models.

This study highlights that the widespread adoption of simulation-based and scenario-driven training has a significant practical outcome: these methods enhance empathy and improve effective decision-making skills under stress by allowing participants to experience their roles in real operational conditions.

Educational institutions are advised to use validated tools like NASA-TLX to systematically measure cognitive load in educational assessments; this allows for evaluation of the impact of educational designs and adjustments to content and methods as needed.

Providing trainers with specialized training in human factors and conflict management plays a critical role in improving training quality. They should not only be transmitters of technical knowledge but also facilitators who promote safe communication and team resource management.

This study highlights that aviation training organizations can improve sustainable safety performance by integrating safety management systems with training programs and incorporating feedback and performance data into their processes.

From an implementation perspective, these results support the development of joint, scenario-driven, and debrief-centered training programs. An effective approach involves conducting short, repeated pilot–ATC micro-scenarios that intentionally create workload asymmetry, such as cockpit abnormal procedures while the controller manages sequencing, or controller sector overload while the cockpit addresses weather deviations. The primary objective is not to induce stress for its own sake, but to make the workload observable and open to discussion. This includes identifying cues that signal overload, examining communication strategies that reduce friction, and evaluating how pacing and intent sharing enhance coordination. It is essential that debriefings capture both explicit statements and underlying assumptions, as conflicts often arise from unspoken priorities, constraints, and timing. Integrating these training outcomes into an organization’s SMS through recurrent themes, communication hotspots, and scenario libraries linked to real event reports can transform training from a one-time intervention into a continuously evolving safety control process.

10. LIMITATIONS AND FUTURE RESEARCH

While this research contributes to the literature by examining the impact of technical training on pilot-air traffic controller interactions, it is susceptible to measurement errors such as social desirability and perceptual biases due to its reliance on participants' subjective reports. This limits the validity of variables such as perceived workload and conflict level.

The research was conducted on pilots and air traffic controllers working in specific operational environments, and the generalization of the findings to all international aviation systems is limited due to variations in airspace density, cultural factors, training policies, and procedures from country to country. Comparative studies would enhance external validity.

While the cross-sectional design of the study reveals relationships between variables, it does not fully explain the causal dynamics over time. Future longitudinal studies could better assess the long-term impacts and sustainability of technical education interventions. Because all variables were collected using self-reported questionnaires, common method bias cannot be completely excluded.

Future research using advanced data collection techniques such as in-depth interviews, focus group discussions, and operational observations will contribute to a better understanding of conflict dynamics and workload perception in pilot-controller interactions. Simulation-based experimental designs are also important in measuring the behavioral effects of training interventions.

Future studies are recommended to examine the relationship between technical training and operational safety performance using objective metrics such as incident reports, air traffic incident statistics, failure rates and SMS data, in addition to perceptual indicators. Multidimensional and mixed methods will more clearly reveal the true impact of technical training on aviation safety.

Future studies will make significant contributions to human factors-based safety research in aviation by deepening the theoretical framework and offering concrete policy recommendations for application.

Several future research directions could strengthen the evidence base and shift the emphasis from perceptual outcomes to operational safety indicators. First, supplementing

self-report measures with behavioral and performance proxies, such as communication timing metrics, readback or clarification rates, simulator separation-loss precursors, or operational event reports, would help reduce social desirability bias and triangulate perceived workload with observable manifestations. Second, longitudinal research designs could assess whether training effects persist, diminish, or intensify with recurrent refreshers, and whether transfer varies by experience level or operational environment, such as tower, approach, area, short-haul, or long-haul contexts. Third, comparative or multi-country replication studies would clarify the influence of cultural communication norms and differing air traffic control procedures on conflict dynamics. Finally, future studies could evaluate whether specific training components, including joint simulation, structured debriefing, or workload-awareness modules, are more effective than bundled programs, thereby informing cost-effective training architectures and regulatory guidance.

Appendix

Appendix 1A

Appendix 1A. Survey Item for Pilot

1st Section

Demographic Information

Gender *

- Woman
- Man
- I do not want to specify

Age*

Marital Status *

- Married
- Single

Education Status *

- High School
- Associate Degree
- Bachelor Degree
- Master's degree and above

Experience in the Aviation Industry *

- 0–5 year
- 6–10 year
- 11–15 year
- 16 year and above

2nd Section					
Perception of Communication and Teamwork					
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
In general, my communication with the ATC team is clear and understandable.*					
I can cooperate effectively with ATC in difficult situations.*					
I can cooperate effectively with ATC in difficult situations.*					
I think lack of communication can lead to conflict.*					
I understand the information given by the pilots during flight operations in a timely and accurate manner.*					
I believe that open communication with crew members during a flight increases flight safety.*					
I can quickly develop solutions with team members in case of unexpected situations.*					
Did you participate any training in Communication and Teamwork?*					
If yes which type of training you have participate?	In Company Trainings Virtual Reality (VR) and Augmented Reality (AR) Technologies Implementation of the Mentorship Programs Professional development opportunities for Aviation Professionals Industry Conferences and Workshops Mentoring Programs				

How effective was this training for your daily performance? *					
3rd Section					
Conflict Perception and Management					
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
When a disagreement arises, I try to compromise constructively with the other party. *					
In case of conflict, I prefer to communicate directly. *					
Most conflicts arise from lack of communication. *					
Did you participate any training on Conflict Perception and Management?*					
If yes which type of training you have participate?	In Company Trainings Virtual Reality (VR) and Augmented Reality (AR) Technologies Implementation of the Mentorship Programs Professional development opportunities for Aviation Professionals Industry Conferences and Workshops Mentoring Programs				
How effective was this training for your daily performance? *					
4th Section					
Workload Perception					

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
In normal operations, my workload is easy to manage.*					
My stress level increases in heavy air traffic situations.*					
I feel mental fatigue during the flight.*					
Did you participate any training on Time management and Stress Management?*					
If yes which type of training you have participate?	In Company Trainings Virtual Reality (VR) and Augmented Reality (AR) Technologies Implementation of the Mentorship Programs Professional development opportunities for Aviation Professionals Industry Conferences and Workshops Mentoring Programs				
How effective was this training for your daily performance? *					

Appendix 2A.

Appendix 2A. Survey Item for ATC

1st Section

Demographic Information

Gender *

- Woman
- Man
- I do not want to specify

Age*

Marital Status *

- Married
- Single

Education Status *

- High School
- Associate Degree
- Bachelor Degree
- Master's degree and above

Experience in the Aviation Industry *

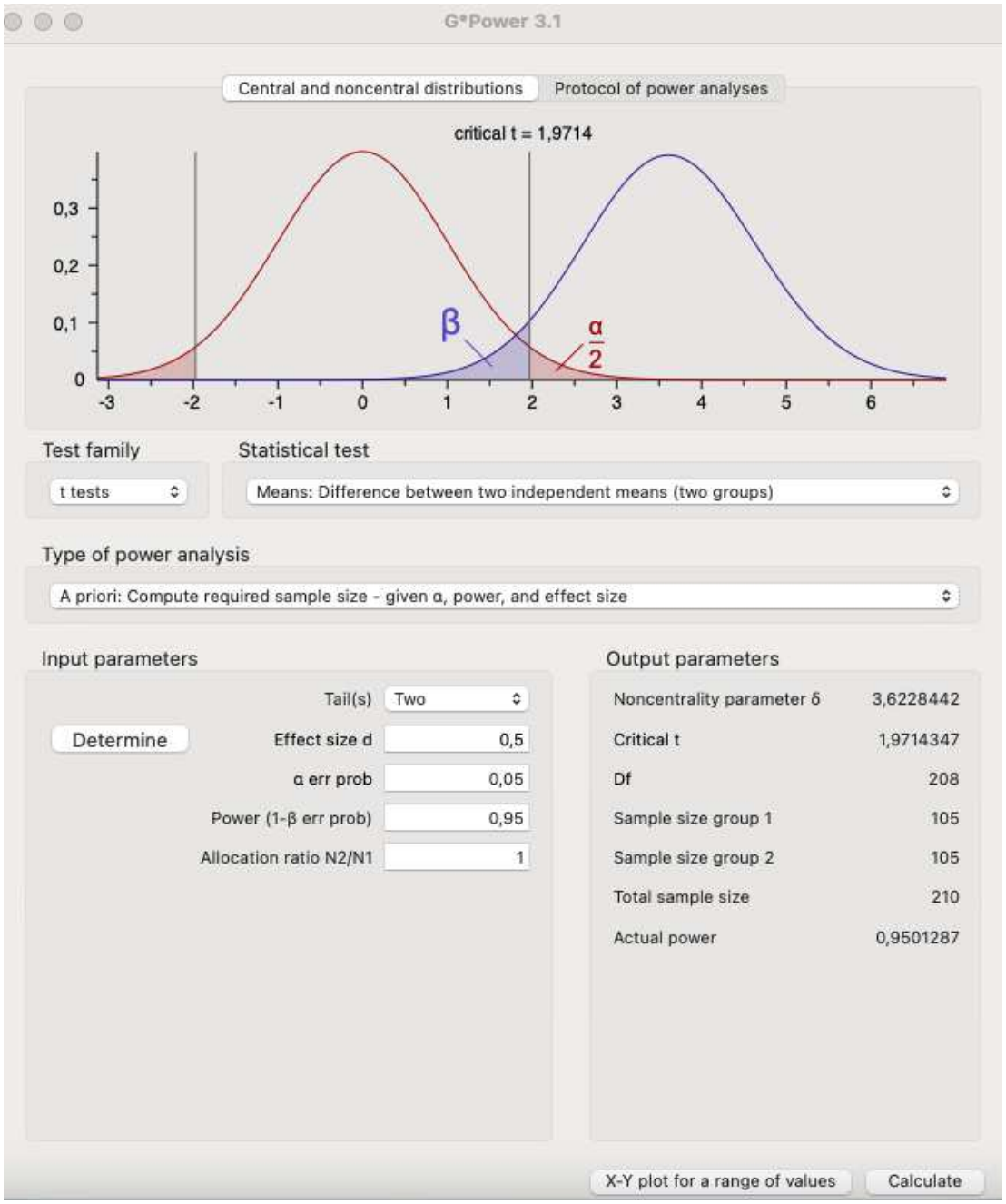
- 0–5 year
- 6–10 year
- 11–15 year
- 16 year and above

2nd Section					
Perception of Communication and Teamwork					
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
In general, my communication with the pilots is clear and understandable.*					
I can cooperate effectively with pilots in difficult situations.*					
I think lack of communication can lead to conflict.*					
I understand the information given by the pilots during flight operations in a timely and accurate manner.*					
I can quickly develop solutions with team members in case of unexpected situations.*					
Did you participate any training on Communication and Teamwork?*					
If yes which type of training you have participate?	In Company Trainings Virtual Reality (VR) and Augmented Reality (AR) Technologies Implementation of the Mentorship Programs Professional development opportunities for Aviation Professionals Industry Conferences and Workshops Mentoring Programs				
How effective was this training for your daily performance? *					

3rd Section					
Conflict Perception and Management					
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
When a disagreement arises, I try to compromise constructively with the other party. *					
In case of conflict, I prefer to communicate directly. *					
Most conflicts arise from lack of communication. *					
Did you participate any training on Conflict Perception and Management?*					
If yes which type of training you have participate?	In Company Trainings Virtual Reality (VR) and Augmented Reality (AR) Technologies Implementation of the Mentorship Programs Professional development opportunities for Aviation Professionals Industry Conferences and Workshops Mentoring Programs				
How effective was this training for your daily performance? *					
4th Section					
Workload Perception					
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

In normal operations, my workload is easy to manage.*					
My stress level increases in heavy air traffic situations.*					
Did you participate any training on Time management and Stress Management?*					
If yes which type of training you have participate?	In Company Trainings Virtual Reality (VR) and Augmented Reality (AR) Technologies Implementation of the Mentorship Programs Professional development opportunities for Aviation Professionals Industry Conferences and Workshops Mentoring Programs				
How effective was this training for your daily performance? *					

Appendix B



Data Availability Statement

The datasets generated and/or analysed during the current study are not publicly available due to privacy and confidentiality considerations related to the participants but are available from the corresponding author on reasonable request.

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