Optimizing Risk Mitigation with Advanced Interpersonal Skills Training

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Abstract

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This dissertation presents a novel approach to improving aviation safety that focuses on the sociotechnical framework of the flight deck. By analyzing data from 1,600 experienced pilots from a leading US airline, I find that advanced interpersonal skills training plays a pivotal role in safety improvement by optimizing risk mitigation strategies in reducing pilots' self-silencing behaviors. Teaching pilots previously untaught skills such as bias literacy, psychological safety, interpersonal communication, and resilience can optimize risk mitigation and improve the efficacy of Crew Resource Management (CRM) and Threat and Error Management (TEM).

I utilize a mixed-methods approach, combining quantitative data from a longitudinal analysis of survey data centered around a lecture-based training intervention with qualitative insights from semi-structured interviews. The intervention led to a statistically significant greater endorsement of interpersonal skills, particularly among non-prototype pilots (women and non-White male aviators). A model I call the “Safety Voice Reduction Sequence” illustrates the detrimental impact of certain captain behaviors on psychological safety in the flight deck microculture.

Another model I term the “Optimized Risk Mitigation Model for Sociotechnical Systems” (a model emphasizing advanced interpersonal skills training to increase the resilience of the sociotechnical system) introduces a transformative approach to pilot human factors training rooted in empirical research findings. This model advocates for the inclusion of specialized training content aimed at bolstering interpersonal skills capabilities within flight operations, directly contributing to enhanced safety outcomes and optimized risk mitigation strategies.

This dissertation underscores the critical importance of enhancing interpersonal skills among pilots through specialized training interventions, revealing how addressing self-silencing behaviors and fostering psychological safety can significantly improve aviation safety by optimizing risk mitigation within the sociotechnical framework of the flight deck.

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Chapter 1 - Foundations and Frameworks: Establishing the Motivations, Methodologies, and Significance of the Research Inquiry

In this dissertation, we explore and propose enhancements to global aviation safety models and systems, leveraging a human-centered approach to data science. We examine the evolution and impact of Crew Resource Management (CRM), an international crew training model that emerged independently but chronologically in parallel to the 1970s demographic diversification of the flight deck. Since its inception, CRM has played a pivotal role in advancing aviation safety by diminishing the hierarchical power distance between the Captain and the First Officer, fostering collaborative input from all crew members, including dispatchers, flight attendants, and ramp agents, and emphasizing the significance of interpersonal skills through formalized training protocols. Despite the undeniable contributions of CRM to aviation safety, there is still room for improvement. The research questions within this dissertation aim to address and identify latent, unmitigated risk due to a lack of specific interpersonal skills within the pilot cohort.

We draw upon the expertise of industry professionals, safety leaders, and airline pilots to focus on the present state of interpersonal skills training within the aviation industry as a mechanism for augmenting safety. This includes a detailed examination of concepts such as safety voice (the sharing of safety information in a clear manner – a concept discussed more thoroughly in Chapter 3) and threat recognition, which are pivotal in shaping operational safety protocols. The research aims to gauge the extent to which pilots endorse interpersonal skills as integral to aviation safety, seeks to unearth risks that remain overlooked in existing safety models, and considers the potential of focusing on crew collaboration to further enhance aircraft safety. Additionally, it explores the unique experiences of non-prototype pilots (that is, women and non-White men) to gain a deeper understanding of crew dynamics and safety.

1.1 Chapter Overview

This chapter outlines my personal as well as academic motivations for pursuing research in aviation safety. It reflects on my positionality within the context of this research, detailing how my background, experiences, and perspective shape the approach and interpretation of the study.

Further, the conceptual framework that forms the backbone of this dissertation is presented. The chapter also discusses the rationale behind the adoption of a mixed-method research design.

The chapter introduces the central research questions that drive the inquiry, laying the groundwork for the subsequent detailed examination of these topics. These questions are pivotal in directing the research toward its goal of enhancing aviation safety through innovative and human-centric approaches. The chapter concludes with a

discussion of the potential significance of the research findings, both in terms of contributing to academic knowledge and practical applications in aviation safety training and diversity initiatives.

1.2 Motivation

As a professional pilot who has received years of formalized CRM training and uses the concepts every time I operate an aircraft, I understand the importance of setting the right tone in the flight deck to create crew synergy. Over my 18+ years as a pilot, I have first-hand experience of how gender bias degrades the flight deck microculture and devalues the potential positive effects of CRM training. Early in my career, the gender bias and occasional gender harassment I received altered my behavior in the flight deck. I felt less confident to speak up, more worried about my performance, and found myself feeling as though I had to work twice as hard for half the credit. I wondered if others felt similarly. The more I asked colleagues and fellow female aviators, the more I realized it was a ubiquitous phenomenon that extended beyond country borders and across all types (e.g., airline, corporate, charter, etc.) of professional aviation. Women around the world were sharing similar experiences, and those experiences were not limited to one type of operation. Women at airlines, charter companies, flight instructors, and those operating business jets were sharing similar stories. The more I dug into the issue, the more I came to realize it was a global issue.

While new to me, this phenomenon was not new. It had been well documented to the general public (see Captain Beatty's blog, "'Another Empty Kitchen' A compilation of the awful things people say to women pilots" (Beatty, 2021) and it had been well researched in academia (see Walton & Politano, 2014; Vermeulen & Mitchell, 2007; Yanıkoğlu, Kılıç, & Küçükönal, 2020; Zirulnik & Orbe, 2019). I began wondering if the bias-erodes-CRM phenomenon extended beyond gender bias.

These experiences motivated me to explore whether a solution existed within the framework of the safety models and systems currently omnipresent in professional aviation (that is, Crew Resource Management, Threat and Error Management, and Safety Management System).

I also began to wonder how power – specifically unearned power (a concept I explore more in Chapter 4) – and interpersonal skills have impacted the efficacy of these aviation safety models. It was a topic unaddressed in training and, therefore, overlooked by the industry. This overlooked phenomenon is a risk that goes unidentified and unmitigated.

I write this dissertation as a proposal for continued improvement of human factors training. Here I will offer a novel model aimed at enhancing safety through risk reduction in any sociotechnical system.

1.3 Positionality Statement

The term *positionality* is used to describe both "an individual's worldview and the position they adopt about a research task and its social and political context" (Holmes,

2020, p 1). Researchers should acknowledge their positionality as it has been shown to influence their research. Since data (both quantitative and qualitative) are reductions of our experiences (Bernard & Ryan, 2010, p. 5) sharing one's positionality aids in the transparency of the frames utilized in data collection, condensing, and presentation.

I am a white woman born in the United States. My love of travel, penchant for science, and proclivity for challenges led me to a career as a pilot. My undergraduate degree is a Bachelor of Science in Aviation: Flight Operations. I learned how to fly as part of the degree program.

Early in my career, I flew for two airlines (one domestic and one international) and then, in 2009, I switched to business aviation. I have spent the past thirteen years operating long-range executive business jets around the world. I returned to the airline industry in 2023 where I currently (as of this writing) fly for a major US carrier.

That I am a caregiver has also affected my positionality. As a mother of two young daughters, I began to see the industry that I had loved for years as an obstacle to motherhood. I began to notice that it was much easier for pilots who did not have caregiving responsibilities (either because they did not have children or because they had a stay-at-home partner). More dishearteningly, I began to notice managers rewarding pilots for saying "yes" to pop-up trips for extended periods (e.g., 24-hour notice to be gone for three weeks). Pilots who were free of caregiving responsibilities were able to say "yes" to operating with a lack of schedule predictability and no confirmed days off (pilots normally don't get weekends off so, if you want a predictable day off, you take a vacation day). The ideal business aviation pilot was, inarguably, a pilot free of caregiving responsibilities. They were the pilots being rewarded for *being a team player* by packing a bag at a moment's notice and being halfway around the world for three weeks at a time. The ideal pilot wasn't likely to be a caregiver. While my research does not specifically address these exclusionary systemic issues for caregivers, these lived experiences comprise my positionality and, therefore, warrant acknowledgment. It should be noted that flight attendants are expected to encounter similar levels of schedule unpredictability as pilots. Thus, the lack of women pilots cannot be simplistically attributed solely to caregiving responsibilities. Flight attendants face comparable caregiving challenges as pilots.

I am also a trained professional in human factors and aviation safety systems. I have received 18+ years of CRM, TEM, and SMS training. Previously, I held the position of Safety Officer responsible for implementing a Safety Management System in my flight department. In various flight departments over my career, I observed managers creating a tone that would silence pilots. It was reminiscent of the self-silencing I had employed in the flight deck when extreme forms of bias existed. These experiences made me realize that safety silence, that is, withholding safety-sensitive information (see (Noort, Reader, & Gillespie, 2021) extended beyond the flight deck. While this dissertation focuses on the microculture of the flight deck, its concepts and themes are immediately pertinent to any organization's safety reporting, safety performance indicators, and overall safety culture.

1.4 Epistemological Paradigm

Any academic research makes an epistemological claim (Bryant & Charmaz, 2007) and multiple epistemological paradigms are not recommended to be intermixed within a research project (Morgan, 1998). Therefore, I find it important to discuss the epistemological paradigm used throughout this thesis.

Epistemology is the theory of knowledge (Greco, 2017). More specifically, it is the framework used to realize how we can know anything. There are two key philosophical underpinnings of how we might know something relative to research: positivism and interpretivism.

Positivism relies on the expectation of "a priori fixed relationships within phenomena" (Orlikowski & Baroudi, 1990, p. 5). This is the belief that the relationships between whatever makes up phenomena are or may be inherent, predetermined, and established before any specific observations of them occur. Often deductive reasoning is used to test theories. Positivists believe there is a singular Truth out there - pure data - inherent in whatever is being studied or examined, waiting to be discovered by a researcher.

In contrast, interpretivism considers humans and human interaction as different from physical phenomena. There are a multitude of variables (e.g., culture, social realities, biases, situations, etc.) that influence outcomes. Interprevists aim to gather rich data by acknowledging these variables and ground their research in the belief that people generate meaning as they interact and interpret meaning from those interactions in the world around them (Orlikowski & Baroudi, 1990). Interprevists, therefore, must acknowledge that each researcher sees data through their own frames. We further influence the data by condensing it and choosing how and what is shared. There isn't a singular Truth waiting to be discovered. Instead, there are many truths, each true through the construction of the frame used in observation. Interpretivists often use inductive reasoning, which requires one to study a range of cases to extrapolate overarching themes and a conceptual category (Charmaz, 2006). While this method may appear more holistic, logistical problems could arise from perpetually querying whether one has enough data or has considered all variables. When does the exploration ever end?

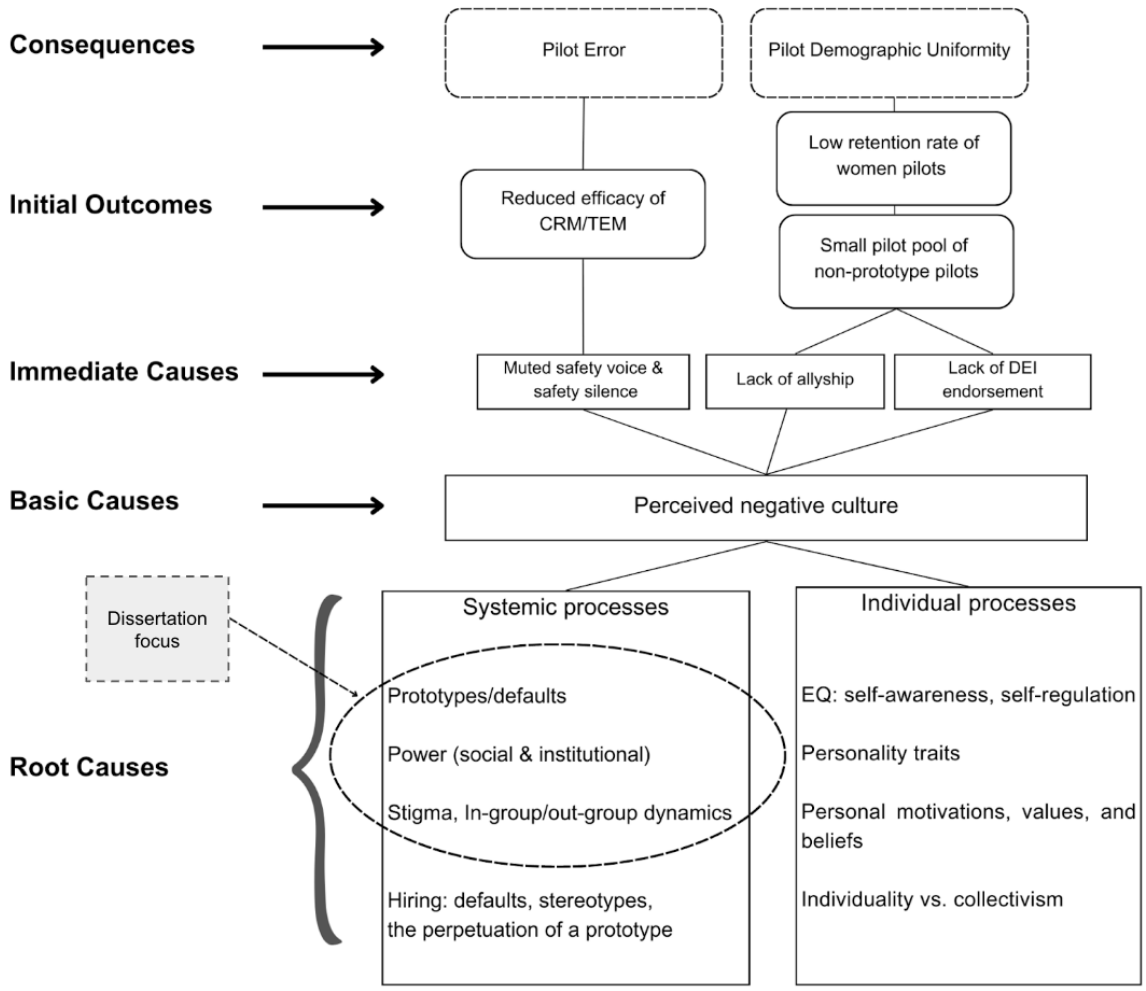
While I appreciate the complexity and thoroughness of this philosophical inquiry, I adopt an epistemological framework near the midpoint of the positivist-interpretivist spectrum. This thesis explores both confirmatory research questions requiring hypothesis testing and exploratory research questions utilizing grounded theory techniques. In my grounded theory exploratory research, I utilize abductive reasoning (Bryant & Charmaz, 2007) to consider possible theoretical explanations, check them empirically by re-examining the data, and pursue the most plausible explanation (Charmaz, 2006). It is through this blended approach that I offer scientifically derived insight on interpersonal skills to enhance aviation safety by optimizing risk mitigation.

1.5 Conceptual Framework

I created a conceptual framework to show a link between pilot error in the flight deck and pilot demographic uniformity within the industry. The framework offers a visual representation of how a perceived negative culture is the basic cause of the consequences of pilot error and lack of diversity. It offers intermediate causes and initial outcomes to demonstrate the connection between these two consequences.

Figure 1.5

Conceptual Framework



Note: “EQ” in Figure 1.5 refers to “emotional intelligence”, which can be defined as the ability to interpret and use one’s own and other people’s emotions to guide thinking and behavior (Strivastava, 2013).

Pilot error can occur for a variety of reasons (e.g., cognitive degradation, hazardous attitudes, a lack of training, etc.). These explanations spotlight the errors of an individual pilot caused by errors in that pilot’s processes. I am more interested in

errors that occur because of the degradation of the flight deck microculture resulting in pilots' self-silencing. This type of pilot error results from self-silencing in varying levels of severity from muted safety voice to safety silence (see Chapter 3). I identified the reduction of CRM/TEM efficacy (initial outcome) and muted safety voice/safety silence (immediate causes) as focal points as I moved more deeply into the root cause analysis. Within the conceptual framework, I theorize the basic cause as a perceived negative culture, which is at an intersection of the second consequence, pilot demographic uniformity.

In terms of pilot demographic uniformity, pilots holding the Airline Transport Pilot license are 95% male and 94% white (Federal Aviation Administration, 2022). This is partially due to a low retention rate of women pilots. Women comprise 14.5% of student pilots (Women in Aviation, 2020) but a mere 3.6% as airline Captains (Federal Aviation Administration, 2022) and make up a small pool of non-White male candidates. The immediate causes of these outcomes are a lack of allyship and a lack of diversity, equity, and inclusion (DEI) support.

It has been well documented (see, the Women in Aviation Advisory Board Report (Federal Aviation Administration, 2022) and Chapter 4 of this thesis) that a negative culture toward women contributes to their absence in the industry. Based on research conducted as part of this doctoral program (see Chapter 4), immediate causes of this demographic uniformity consequence were identified as a lack of allyship (see section 4.7) and a disconnect between the flight department's DEI initiatives' stated goals and employee sentiment toward DEI initiatives.

As can be seen in Figure 1.5, I identified a perceived negative culture as the basic cause of all immediate causes. A perceived negative culture instigated by one pilot (often the pilot with authority - the Captain) can cause their flying partner (often the First Officer) to retreat into self-silencing as a self-preservation maneuver. Likewise, a perceived negative culture by *othering* non-prototype pilots causes distrust and negative sentiment for DEI initiatives. These concepts are explored in full in section 4.6.

Whether a culture is perceived as negative, positive, or neutral depends on the perspective of the person experiencing it. In other words, it is subjective. To address the subjectivity, I identified several possible causes. I then looked at culture creation through both individual processes and systemic processes. Identifying root causes generated by an individual process (emotional intelligence, personality traits, etc.) is best suited for clinical psychologists. While it can be argued that these individual traits become part of the systemic issues during the hiring process, a concept I briefly address later, it is beyond the scope of this thesis. My research employs a social-psychological perspective of strengthening the sociotechnical system functionality through interpersonal skills. Therefore, I focus my doctoral research on the systemic causes of culture with particular attention to the microculture of the flight deck: prototypes, defaults, stereotypes, power, stigma, and in-group/out-group dynamics.

1.6 Methods Overview

Both quantitative and qualitative data are reductions of our experiences (Bernard & Ryan, 2010). Researchers reduce data through their research question selection

process choosing which facets of a concept to spotlight and which facets to acknowledge and which facets to ignore completely. Researchers then further reduce the data by choosing which data to analyze and how to analyze it. We condense this data into (hopefully) meaningful findings. I employ both qualitative and quantitative research methods as a way to cross-validate overarching theories relevant to the constructs this writing explores.

The design of this study was intended to find a balance between the generalizability of large numbers of quantitative data and the information-rich qualitative data. I, therefore, found it necessary to utilize a mixed-method approach. This was strategic, as some research questions were confirmatory requiring hypothesis testing while others were exploratory and best researched through a grounded theory approach to find emergent themes. Quantitative data is suited for testing hypotheses (Bernard & Ryan, 2010), whereas qualitative data is best used in exploration and discovery (Charmaz, 2006).

1.6.1 Quantitative Design

The quantitative data collection method is a three-part survey designed to offer a longitudinal study measuring respondents' understanding of and sentiment (attitude) toward several interpersonal skills constructs before and after a training intervention (further discussed in Chapter 5).

Questions for the survey were designed and iterated after testing was conducted on non-participating subjects with backgrounds similar to those of the research participants. As three of the interpersonal skills constructs were new to the aviation industry, I was particularly interested in measuring attitudes toward them.

Attitude involves both cognitive and affective dimensions. More specifically, it can be defined as affect for or against or a "positiveness or negativeness toward an object" (Mueller, 1986, p. 3). There are common threads between the constructs of attitude and value (e.g., both require the evaluation of something.)

For my research, I adopt the definition of value as an "enduring belief that a specific mode of conduct or end state of existence is personally or socially preferable to an opposite or converse mode of conduct or end state of existence" (Rokeach, 1973, p. 5).

Some social psychologists argue that values cause attitudes (Mueller, 1986). Attitudes are functions of whether a cognitive object, person, group, etc. facilitates the attainment of a certain value. For example, if a pilot values homogeneity, their attitudes toward diversity may be negative. But it is not a single value that generates an attitude. An attitude is caused by a taxonomy of values (Mueller, 1986).

If I am interviewing a new hire pilot, my value system tells me the relative importance of assessing their social skills, stick-and-rudder skills, tone, demeanor, competency, emotional intelligence, etc. My attitude toward this person is determined by a taxonomy or a hierarchical ordering of how these values are fulfilled by the person in question. If I value authenticity, transparency, and humility, but my co-interviewer values authoritativeness and boldness, our attitudes toward the interviewee will likely diverge.

Individual belief systems exert a substantial influence over one's emotional responses towards various stimuli, and these responses are in turn shaped by one's predispositions. For instance, harboring favorable sentiments towards a collective entity predisposes an individual to accept positive assertions regarding that collective (Mueller, 1986). Consequently, the quantification of an attitude involves eliciting an individual's emotional position or belief concerning a particular entity or concept. This quantification is operationalized by positioning an individual's affective response on a continuum ranging from highly favorable to highly unfavorable (Mueller, 1986, p. 6). Such a methodological approach was employed to ascertain the value placed on safety-centric interpersonal skills by research participants.

The relational dynamics among belief structures, emotional responses, and behavioral inclinations towards entities, ideologies, individuals, and so forth, are intricately linked, providing valuable insights into the attitudinal landscape (Mueller, 1986, p. 10). In light of the above, Likert scales encompassing both five-point and seven-point ranges were utilized within the survey to gauge the participants' receptivity to emergent concepts pertaining to advanced interpersonal skills.

Much of the data collected was non-parametric, meaning we cannot make assumptions about the distribution of the data (DePuy & Pappas, 2004). This thesis utilized a Wilcoxon signed rank test to explore survey data pre- and post-intervention.

1.6.2 Qualitative

The qualitative data collection methodology was operationalized via semi-structured interviews implemented subsequent to the intervention phase. An interview protocol was developed to direct the inquiry, thereby facilitating the enhancement of quantitative findings pertinent to the confirmatory research queries. Concurrently, the integration of open-ended questions within the interview schema was strategically designed to assemble a rich dataset, which was instrumental for the in-depth examination of exploratory research questions.

Blending sampling strategies can be beneficial in research. Quantitative methods often rely on probability theory in mixed method designs, while qualitative methods typically use purposeful sampling to identify specific individuals experiencing a phenomenon of interest. In this study, two research inquiries focused on power dynamics and demographic factors. Due to homogeneity in occupational experience and demographics among participants (see Chapter 5), a stratified purposive sampling technique was used to capture diverse responses rather than a single perspective (Palinkas et al., 2015). This approach is effective for engaging underrepresented or difficult-to-access populations, such as individuals who deviate from the typical demographic profile within the pilot cohort (e.g., non-White male pilots) (Bernard & Ryan, 2010).

Subsequent to the interviews, a transcription process was undertaken. These transcriptions underwent multiple iterations of qualitative coding, and analytical memos were generated to explicate emerging thematic patterns. The synthesis of inductively derived codes and those grounded in theoretical frameworks are presented in

subsequent chapters. The coding process is more thoroughly analyzed in section 5.6.1. When appropriate to the specific research question, this thesis offers a succinct synthesis of the thematic commonalities emergent across the interview corpus.

1.7 Central Research Questions

I categorized my research questions into three overarching themes: 1) measuring a baseline, 2) intervention effectiveness in influencing participants' attitudes, and 3) methods of building psychological safety in the flight deck. My first two research questions (RQ1 and RQ2) are confirmatory and have complimentary hypotheses while the third research question (RQ3) is exploratory.

Measuring a baseline
RQ1 (confirmatory) Have industry safety leaders been trained on the FAA-recommended interpersonal skills?
H: Safety leaders have a higher level of training on FAA-recommended interpersonal skills than the general population of pilots.

RQ2 (confirmatory) Do industry safety leaders believe that FAA-recommended interpersonal skills are important for safety?
H: Industry safety leaders, in general, believe that FAA-recommended interpersonal skills are important for safety.

RQ3 (exploratory) How do industry safety leaders perceive the importance of training pilots on advanced interpersonal skills (cognitive bias, psychological safety, and interpersonal communication) as a process to enhance safety prior to an intervention?

Research question 4 (RQ4) transitions from measuring a baseline of participants' understanding of interpersonal skills to measuring the effectiveness of the intervention. Moreover, it aims to explore whether a lecture-based intervention influences participants' attitudes, sentiments, and endorsement for advanced interpersonal skills training. As it is confirmatory, a complementary hypothesis is provided.

Intervention effectiveness
RQ4 (Confirmatory) How does endorsement for advanced interpersonal skills training change after a lecture-based intervention?
H: Pilots will have an increased endorsement for training on advanced interpersonal skills after a one-hour, lecture-based training on the concepts.

Additionally, in the context of Research Question 4, the investigation focuses on identifying the demographic segments that have demonstrated the most significant positive temporal variations.

The final research questions are central to my proposed theoretical model for enhancing safety (see Chapter 9). After establishing a baseline (RQ1-3) and measuring

whether the pilot group would be receptive to advanced interpersonal skills training (RQ4), I aimed to examine the nuances of the flight deck microculture creation. I consider the following research questions to be the most significant contribution to the advancement of sociotechnical human performance training while also providing insight for organizational leaders with goals of workforce diversification.

Confirmatory Research Question 5 (RQ5) is integrally connected to the insights obtained from Research Question 4 (RQ4), building upon the premise to ascertain the extent to which demographic factors, specifically minority or out-group membership status, serve as predictors of attitudinal orientations towards the adoption of advanced interpersonal skills training as a strategy for enhancing safety on the flight deck.

Subsequent research inquiries, namely RQ6, RQ7, and RQ8, adopt an exploratory framework centered on the construct of psychological safety. Research Question 6 (RQ6) advances in a trajectory parallel to RQ4 and RQ5, undertaking a critical examination of response patterns vis-à-vis institutional power dynamics (that is, Captain vs. First Officer). In contrast, RQ7 delves into the behavioral dimensions requisite for the establishment of psychological safety within the confines of the flight deck. Research Question 8 (RQ8) is dedicated to elucidating the function of resilience as a cornerstone in the sustenance of psychological safety.

Power, Behaviorism, and Resiliency

RQ5 (confirmatory) Does membership in a marginalized group status predict the level of perceived importance for flight deck advanced interpersonal skills training?

H. Non-prototype pilots will have a higher level of endorsement of FAA and advanced interpersonal skills training before the intervention.

RQ6 (exploratory) How is low psychological safety in the flight deck manifested across various positions of power?

RQ7 (exploratory) Which flight deck behaviors build psychological safety?

RQ8 (exploratory) What is the perceived role of individual resiliency in building flight deck psychological safety?

1.8 Research Significance

This study is posited as a pivotal contribution to the field as it offers three distinct outcomes: 1) diminution of risk within the flight deck milieu via the amplification of safety voice for the identification and rectification of threats and errors; 2) the cultivation of safety-oriented employee behaviorism to bolster the probability of adherence to Standard Operating Procedures (SOPs) and active engagement in safety discourse; and 3) the fostering of an organizational culture that supports the integration of a diverse workforce, particularly the inclusion of women aviators.

Moreover, this study serves to bridge and rectify the gap in efficacy identified within the Crew Resource Management (CRM) and Threat and Error Management

(TEM) frameworks. The investigation reveals that pilots may resort to self-censorship in environments where the microculture is devoid of psychological safety. Contemporary aviation human factors training programs are yet to incorporate the advanced interpersonal skills vital for the establishment and maintenance of psychological safety, as well as for the remediation of microcultures that have been adversely affected. Given the ongoing prominence of pilot error as a primary cause of aviation accidents (Shappel et al., 2006), it is evident that extant safety models aimed at mitigating pilot error need further development as part of a continuous improvement process.

By conceptualizing the flight deck as a sociotechnical interface, I propose an innovative instructional approach aimed at enhancing social psychological competencies among pilots, labeled as ‘advanced interpersonal skills’ throughout this thesis. Such competencies are postulated to mitigate the prevalence of crewmember reticence in voicing safety concerns, thereby reducing risk and fostering a more open and communicative operational environment. In this vein, the study seeks to lay a foundational framework for the evolution of Crew Resource Management (CRM) and Threat and Error Management (TEM) training methodologies.

Additionally, I present a systemic methodology to rectify deficiencies in existing diversity initiatives and strategies. This relevance is twofold: firstly, it addresses the inadequacies of conventional diversity training programs, as critiqued by (Dobbin & Kalev, 2022), and secondly, it confronts the glacial pace of integrating female pilots into the professional cockpit, which has been projected at a staggering 430 years to achieve gender parity at the current rate of recruitment. I offer a multifaceted solution with the potential to not only diminish the incidence of pilot error but also to enhance the efficacy of diversity training and cultivate an environment that supports the accelerated integration, recruitment, and sustained engagement of non-prototype pilots, particularly women aviators.

1.9 Chapter Conclusion

This chapter began with an exploration of my motivations for the research, followed by articulating my epistemological stance. The chapter presented a conceptual framework, justifying the mixed-method research design for comprehensive understanding, and introduced central research questions aligning with the study's objectives. It concluded by discussing the broader significance of the research within safety training and diversity initiatives, mapping its potential impact on practices, policies, and theoretical understandings.

The following chapter analyzes key stakeholders in aviation, focusing on their role in safety policy and human performance expectations for pilots. It also addresses the regulatory influence of non-governmental entities and proposes strategies to integrate advanced interpersonal skills.

Chapter 2 - A Brief Overview of the Industry's Human Factors Mandates

2.1 Chapter Overview

Chapter 1 served the purpose of providing readers with the context behind the research, including my motivation and positionality. This was crucial for ensuring transparency regarding the perspective through which the research was conducted. Chapter 2 begins to provide structure for the research. It outlines the key stakeholders of the aviation industry and their contributions to the policy recommendation and enforcement of safety paradigms and systems. It examines human performance (HP) as a sub-category of human factors (HF) and explores stakeholders' stated HP and HF expectations of pilots on interpersonal skills.

2.2 Aviation's Key Stakeholders

Aviation industry regulations, rules, and standards derive from a complex lineage of influencers that begins at the global level and ends with individual operators. This section offers a brief overview of two areas of that lineage - training and standards. It begins with a global view and concludes with a brief background of non-governmental organizations influencing the United States airline operators. Table 2.2 offers a quick overview of the stakeholders that will be discussed in the upcoming subsections.

Table 2.2
Overview of some of the Aviation Industry's Stakeholders

Stakeholder	Overview	Outputs	Applicable Sections
International Civil Aviation Organization (ICAO)	a specialized agency of the United Nations to promote the safe development of civil aviation worldwide	creates international Standards and Recommended Practices (SARPs) distributed through Annexes	Annex 6 the *Operation of Aircraft,* and Annex 19 *Safety Management*
Federal Aviation Administration (FAA)	under the Department of Transportation. Regulates civil aviation in the United States	creates Federal Aviation Regulations (FARs) divided into Parts and elaborates on regulations through Advisory Circulars (ACs)	Part 5, Safety Management Systems; Part 61, Certification: Pilots, Flight Instructors, and Ground Instructors; and Part 121 Air Carrier

			Certification. AC120-51E *Crew Resource Management Training*
International Air Transportation Association (IATA)	global trade association	publishes recommendations, alliance strategies, and global initiatives	Introduced to understand how they work in conjunction with ICAO to recommend human performance and human factors competencies for pilot training.
Air Line Pilots Association (ALPA)	world's largest union	advocates on behalf of pilots to the FAA	Introduced to understand their historical and present stance on diversity initiatives.

2.2.1 International Civil Aviation Organization

To best understand the government-regulated policy in the United States, we must broaden our scope to the global scale. The International Civil Aviation Organization (ICAO) is a specialized agency of the United Nations formed in 1944. As of this writing, it is funded and directed by 193 nation-states. Its panels and task forces are tasked with identifying priorities designed to "enhance global civil aviation safety" (International Civil Aviation Organization, 2023). To meet this objective, ICAO produces Standards and Recommended Practices (SARPs) collectively organized and distributed through Annexes.

As it pertains to human performance and future work on interpersonal skills and safety, there are two Annexes of particular importance: Annex 6 the *Operation of Aircraft,* and Annex 19 *Safety Management* (International Civil Aviation Organization, 2012). Annex 6 establishes the requirement for pilots to receive continuous human factors training and establishes that operators utilize various training platforms (e.g., classroom and flight simulation) to provide pilots with the knowledge and skills related to performance as pilots, also known as human performance (SKYbrary, n.d.).

Annex 19 focuses on safety management and strategies designed to address safety risks by advocating that all organizations implement a Safety Management System (SMS). This initiative led to the publication of ICAO Doc 9859 *Safety Management Manual* (SMM), which includes promoting a positive safety culture and

monitoring and measuring the organization's culture (International Civil Aviation Organization, 2012).

Annex 6 of the International Civil Aviation Organization (ICAO) mandates a universal obligation for the training of pilots in the realm of human performance, underscoring the critical nature of this aspect in aviation operations. Concurrently, Annex 19 elucidates the notion that cultural factors are intrinsically linked to the broader spectrum of aviation safety.

2.2.2 Federal Aviation Administration

ICAO is instrumental in setting global standards, which requires member states to either enact these standards or to formally declare deviations. The FAA deviates on several accounts (see Differences From ICAO Standards, Recommended Practices, and Procedures (Federal Aviation Administration).

The FAA publishes Federal Aviation Regulations (FARs) sub-divided into Parts as a component of Title 14 of the Code of Federal Regulation. This chapter will focus on the following parts: Part 5, Safety Management Systems; Part 61, Certification: Pilots, Flight Instructors, and Ground Instructors; and Part 121 Air Carrier Certification. Pilot training requirements not specifically listed in each of these Parts can be found in the Airman Certification Standards (ACS) manuals.

The FAA establishes only a minimum standard, as seen from the following quote: "We issue and enforce regulations and minimum standards covering manufacturing, operating, and maintaining aircraft" (U.S. Department of Transportation, n.d.). Individual operators (e.g. charter companies or air carriers) can establish stricter standards. It is important to differentiate between flight operations governed by Part 91 (private aircraft operation), Part 135 (non-scheduled charter operations), and Part 121 (scheduled air carrier operations) as the FAA can require different minimum standards for each type of operation. Within the regulatory framework, Part 121 is distinguished by more stringent standards compared to all other operating Parts. As this study is focused on airline pilots, any mention of FAA HF requirements falls within the purview of Part 121 unless noted otherwise.

The FAA updates its regulations through a lengthy rulemaking process. Advisory and Rulemaking Committees (ARC) are composed of members of the aviation community and members of the FAA (United States Department of Transportation, n.d.). The Committee investigates industry concerns, legislative directives, nascent risk factors, advisories from the National Transportation Safety Board (NTSB), and environmental considerations. After a review period and any necessary iterations, the final regulation is codified within the Code of Federal Regulations. In instances where the FAA finds it necessary to offer additional guidance on the implementation of the new regulation, an Advisory Circular (AC) is written and publicly disseminated. This document provides both the rationale and supplementary context for the newly established regulation and offers recommendations for its effective implementation. This writing will examine several ACs in subsequent sections that specifically focus on CRM and leadership training.

It warrants particular emphasis that an Advisory Circular (AC) does not carry the regulatory weight of formal legislation; instead, it furnishes substantive guidance by the FAA on methodologies for the practical application of new regulations. This nuance is important during our examination of AC120-51E - the industry's primary guidance on CRM training content.

2.2.3 Non-Regulatory Stakeholders: IATA & ALPA

While the FAA is the only government regulatory authority in the United States, air carrier operations (e.g., Part 121) are highly influenced by two non-government agencies: the International Air Transportation Association (IATA) and the Air Line Pilots Association (ALPA).

IATA is the world's largest trade association for airlines. It represents approximately 300 airlines around the world which collectively comprise roughly 83% of global air traffic. The association advocates for the interests of air carriers globally, including challenging rules and regulations they deem "unreasonable" (International Air Transport Association, n.d.).

Another influential industry stakeholder is a large union known as the Air Line Pilot Association (ALPA). ALPA, which originated in 1931, is the largest pilot union in the US and represents 67,000+ airline pilots. ALPA advocates for policy changes to the FAA and Congress by positioning itself as the "guardian and defender of the rights and privileges of the professional pilots who are members of the Association" (Air Line Pilots Association, International, n.d.)

2.3 Human Factors and Human Performance Mandates

I emphasize the difference between "Human Factors (HF)" and "Human Performance (HP)" in this subsection as they are, at times, erroneously utilized as interchangeable terms despite being two distinct constructs. The International Civil Aviation Organization (ICAO) in its 2021 *Manual on Human Performance (HP) for Regulators*, distinguishes between these two phrases.

- "Human Performance (HP) refers to how people perform their tasks. HP represents the human contribution to system performance. (International Civil Aviation Organization, 2021, pp. 1-2).
- Human factors (HF) is concerned with the application of what we know about human beings, their abilities, characteristics, and limitations, to the design of equipment they use, environments in which they function, and jobs they perform" (International Civil Aviation Organization, 2021, pp. 1-2).

Human Factors is a multidisciplinary topic pulling in insight from social psychology, cognitive science, behavioral science, and sociology, among others. These disciplines help regulators, managers, and pilots understand human behavior.

In the scholarly context, it is crucial to differentiate "Human Performance" (HP), which assesses the effectiveness of individuals in executing tasks within a system, from

"Human Factors" (HF), which involves integrating knowledge of human abilities and limitations into system design. The former focuses on the outcomes of human-system interaction, while the latter is concerned with optimizing the inputs that influence these outcomes. In other words, Human Factors underpin the conditions for optimal Human Performance. For instance, the design of an aircraft's flight deck (a Human Factors consideration) directly impacts the pilot's operational performance (a Human Performance outcome).

The FAA explains that the discipline of human factors is “devoted to optimizing human performance and reducing human error. It incorporates the methods and principles of the behavioral and social sciences, engineering, and physiology” (Federal Aviation Administration, 2004, p. 2). Prior to the industry’s current human factor mandates, early advocates of HF training defined it as “the applied science of people working together with devices” (Helmreich & Foushee, Why CRM? Empirical and theoretical bases of human factors training, 2010, p. 4). The interplay between human operators and technology is a fundamental component of my research. In Section 3.3, I delve into a more detailed description of this interaction through the lens of sociotechnical systems theory and the concept of distributed cognition. This dissertation will explore HF training paradigms as a means to improve Human Performance (HP).

2.3.1 A Brief Historical Perspective of Human Performance Training

After a series of accidents in the 1970s, crew communication and collaboration emerged as an important safety imperative. Once known as *cockpit resource management* (Federal Aviation Administration, 2004) a team management concept now known as *crew resource management* (CRM) became the industry’s solution to rectifying human error caused by poor crew coordination. Throughout the next several decades, CRM was a voluntary program, and its implementation relied on individual operators and airline leadership.

In 1997, the United States General Accounting Office issued a Report to Congressional Requesters titled “Human Factors: FAA’s Guidance and Oversight of Pilot Crew Rescue Management Training Can Be Improved.” The report quantified pilot performance by stating that 30% of the 169 accidents occurring between 1983 and 1995 were caused, in part, by poor pilot performance (United States General Accounting Office, 1997, p. 5). The report emphatically appealed to the aviation industry to enhance Crew Resource Management (CRM). It lauded CRM as embodying a Human Factors methodology that elevates aviation safety through the mitigation and management of pilot errors (p. 4), as well as offering a strategy for augmenting pilot performance by emphasizing improved coordination (p. 1).

As highlighted in the previous section, the FAA rulemaking process is influenced by congressional mandates. Therefore, as a result of the GAO report, in 1998, the FAA mandated CRM training for all air carrier pilots, flight attendants, and dispatchers (see Federal Aviation Regulation 121.404) in a single-sentence regulation stating that the aforementioned personnel must complete an approved CRM course in order to operate in their role. At the time of the regulation, the FAA offered no training syllabus nor recommended content; it was left to the individual airlines to develop, implement and

assess effectiveness. This lack of oversight generated a problem of incongruity - a problem that persists today.

Airlines, subject to the FAA's ultimate approval, were granted considerable autonomy to develop distinct CRM training programs, leading to a variation in the curriculum and delivery methods across the industry. Such disparity means that industry pilots, as a whole, experience disparate CRM training, contingent upon their airline's training department. Notwithstanding this variability, in 2004, the FAA sought to provide some standardization by issuing an Advisory Circular on Crew Resource Management Training (see AC 120-51E), offering guidelines to aid in the development and evaluation of CRM training. My research examines the components of the Advisory Circular and compares pilot perceptions of receiving the training against the recommended guidelines. It will also examine the history of Crew Resource Management (CRM) to highlight its adaptability, supporting the case for its ongoing evolution to address new challenges in aviation safety.

2.3.2 Crew Resource Management Adaptations

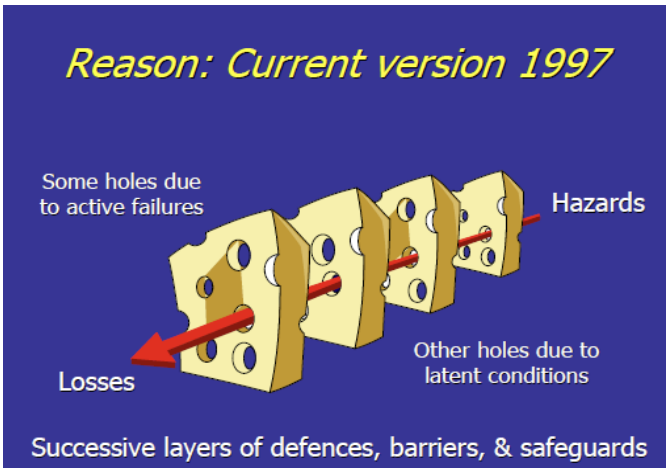
Crew Resource Management (CRM) has undergone a progressive evolution, integrated contemporary scholarly research, and assimilated advanced safety paradigms over time. Thus, CRM has adapted to the needs of the industry through advancements in research. Early on, the Air Force saw a link between coordination and mission performance (Prince & Salas, 1993). As a result, the concept of safety expanded beyond the cockpit to include all personnel in conjunction with the safe operation of the flight deck. Crew Resource Management, despite its detailed and complicated history, has spread and aligned with other well-known safety frameworks like Threat and Error Management.

In the 1990s, a partnership between the University of Texas Human Factors Research Project and Continental Airlines created the Line Operations Safety Audit (LOSA) to observe pilot errors within the context of CRM (SKYbrary, n.d.). A new version of CRM emerged to include an integrated safety model called Threat and Error Management (TEM). TEM is a conceptual model designed to identify, mitigate, and trap errors in the flight deck (SKYbrary, n.d.). It is based on the expectation that pilots will speak up, admit mistakes, ask for help, and share safety concerns.

Threats are events that occur beyond the influence of the crew, whereas errors (either actions or inactions) occur because of the crew (Federal Aviation Administration, 2006). Should threats or errors remain improperly managed, the resultant condition may precipitate an undesired aircraft state, consequently diminishing safety margins. Initial iterations of Threat and Error Management (TEM) frameworks employed the Swiss cheese model, depicted in Figure 2.3.2, wherein the cheese slices symbolize various defensive layers against the incursion of threats and errors, thus, reducing risk. Although the model serves to illustrate the permeability of defenses—how hazards may traverse the gaps—of arguably greater significance is the prevalence of these holes, each representing potential pathways for hazards to compromise safety. This dissertation posits that deficient interpersonal skills constitute a substantial vulnerability within the Swiss cheese paradigm of risk management. This model, as part of error

management, was integrated as a subset of CRM in the FAA's Advisory Circular 120-51E (see *Error Management*, p. 16).

Figure 2.3.2
James Reason's 1997 Threat and Error Management Model



(Reason, 2016)

Despite the proliferation and quick adoptions of the TEM model into CRM, a 2006 FAA-published white paper "Human Error and Commercial Aviation Accidents: A Comprehensive, Fine-Grained Analysis Using HFACS" estimated that 60% - 80% of airplane accidents are due, in part, to human error (Shappel et al., 2006, p. 8).

Contemporary studies have found a deficiency in airline Crew Resource Management (CRM) training, specifically the absence of empirical correlations between demonstrable CRM competencies and measurable safety metrics (Faerevaag, Riveria, Jimenez, & Jentsch, 2018). I explore this safety gap in more detail in subsequent sections.

Although not explicitly denominated as "Crew Resource Management" (CRM), the Federal Aviation Administration (FAA) has recently mandated a novel training regimen for Part 121 pilots. This training, philosophically akin to the interpersonal competencies recommended by the CRM Advisory Circular, was initiated in response to a succession of aviation accidents in the early 2000s, where pilot unprofessionalism was implicated as a contributory factor to the accident (Federal Aviation Administration, 2020). The legislative focus, particularly following the 2009 Colgan Air disaster described in section 7.1.5 of the FAA report, illuminated a safety chasm pertaining to the absence of pilot leadership training within the flight deck. Consequently, the FAA instituted FAR 121.429, stipulating that any airline pilot operating as captain (pilot in command) must undergo specific leadership and command training. A mandate born out of necessity and driven by congressional scrutiny, reminiscent of the beginnings of CRM training.

The parallelism extends further: akin to the original CRM training, which lacked a prescribed syllabus, the leadership and command training also affords airlines the discretion to develop their programs. This has led Human Factors managers to develop

training syllabi without guidance. Although the FAA has issued Advisory Circulars with their recommendations, there remains an absence of a national standard for training content, pedagogy, or metrics to evaluate the efficacy of said training, a situation reflective of the initial challenges encountered in the implementation of CRM training.

2.3.3 Human Performance Training for Non-Part 121 Pilots

So far this study examined pilots governed by Part 121, such as those involved in air carrier operations. Nevertheless, the imperatives of Crew Resource Management (CRM) extend to aviators under the purview of additional regulatory Parts, and mandates for CRM are even embedded within the foundational training for higher-level pilot licensure.

While slightly ambiguous, CRM mandates are sprinkled throughout pilot training. Regardless of which Part a pilot is operating under (e.g., Part 91, 135, or 121), CRM training is required in order to earn an airline transport pilot (ATP) license. FAR Part 61.155 *Aeronautical knowledge* requires ATP candidates to be trained on “Crew resource management to include crew communication and coordination” (Federal Aviation Administration, 2021, p. c13). Furthermore, applicants applying for a multi-engine ATP or type rating must also show they have received “at least 6 hours of instruction in leadership, professional development, crew resource management, and safety culture” (Federal Aviation Administration, 2021) from an authorized training provider.

Initial pilot training programs may only briefly cover Crew Resource Management (CRM), but it ultimately becomes a crucial part of their ongoing professional education. CRM has achieved such a critical position within advanced pilot training that it is now inextricably interwoven with the essence of airmanship itself. During a 2017 Flight Operations Support and Training Standards safety symposium, airmanship was defined as encompassing both the technical acumen and the non-technical faculties—knowledge, skills, and attitudes requisite for the assured, efficient, and effective conduct of flight operations (International Civil Aviation Organization and Airbus, 2017). Within this framework, CRM is identified as the cornerstone of the non-technical dimensions of airmanship.

2.4 Operationalizing and Systematizing CRM: LOSA, FOQA & ASAP

Line Operations Safety Audit (LOSA), briefly introduced in the *CRM Adaptation* subsection, is a voluntary safety program designed for a company to self-assess safety. It was first introduced as a collaboration between the University of Texas at Austin and Continental Airlines, with funding from the Federal Aviation Administration as a process to collect data on flight crew behavior during routine operations. The International Civil Aviation Organization (ICAO) endorsed LOSA as a “primary tool to develop countermeasures to human error in aviation operations” (International Civil Aviation Organization, 2002, p. vii).

The program engages observers to systematically gather data on pilots' behaviors during standard flight operations by positioning an observer in the auxiliary crew seat (jumpseat). A LOSA (Line Operations Safety Audit) observer documents potential hazards, divergences from Standard Operating Procedures (SOPs), and the methodologies employed by aviation teams to navigate and rectify errors and threats. This collected data is used by airlines in evaluating safety margins. As the initiative expanded, the original creators responsible for its inception established a commercial entity, The LOSA Collaborative, to facilitate its execution. The Collaborative's online platform showcases its success by working with more than 80 airlines globally (LOSA Collaborative, n.d.).

While LOSA is lauded for being integral to Crew Resource Management (CRM) training focusing on Threat and Error Management (TEM) by providing real-time insights into system operations (International Civil Aviation Organization, 2002), it is only as good as the auditors' training and the questions being asked in the audit. Specific audit questions are proprietary; however, neither the LOSA Collaborative nor the FAA highlights any mention of bias literacy, resilience, or psychological safety as part of the audit overview on public domains.

Another metric to measure pilot behavior is Flight Operational Quality Assurance (FOQA). It is a safety program that uses recorded flight data to analyze safety margins in day-to-day operations. Sometimes referred to as Flight Data Monitoring (FDM), the program records both aircraft systems and how the aircraft is flown. The data is de-identified and then shared with the FAA, which then summarizes and shares it throughout the industry (Federal Aviation Administration, 2004).

Flight Operational Quality Assurance (FOQA) serves as an analytical instrument to quantitatively evaluate pilot performance within the confines of safety parameters set by the airline. When established benchmarks are not attained—for instance, specific flap configurations at specific speeds, or the precise distance down a runway where an aircraft lands—a FOQA event is triggered. Although this mechanism does not reveal the cognitive processes of pilots who trigger an event or the efficacy of Crew Resource Management, it does furnish data on aircraft operation, thereby offering a perspective on pilot behavior. In cases where aircraft operation transgresses defined safety metrics, the FOQA event review panel undertakes an examination to determine the influence of Crew Resource Management (CRM) on the incident by questioning the pilots who triggered the FOQA event. As a result, FOQA offers a retrospective assessment of CRM effectiveness, only triggered after safety margins have already deteriorated. The Aviation Safety Action Program (ASAP) represents a retrospective evaluative mechanism for Crew Resource Management (CRM) effectiveness, activated post hoc to an adverse event. It is a program that promotes the voluntary disclosure of safety-related issues through a collaborative agreement between the Federal Aviation Administration (FAA) and the respective airline, permitting the exchange of critical safety information, potentially including infractions of FAA regulations (Federal Aviation Administration, 2020). In exchange for essential data that might otherwise remain undisclosed, the FAA may refrain from issuing any punitive enforcement. This program helps uncover hidden safety risks that might otherwise go unreported. When a report is submitted, a committee reviews the event to determine its causes. This allows for the

identification of issues like poor teamwork or CRM, but only if they're mentioned in the report.

Line Operations Safety Audits (LOSA), Flight Operational Quality Assurance (FOQA), and the Aviation Safety Action Program (ASAP) each provide distinct frameworks for assessing the efficacy of Crew Resource Management (CRM). However, FOQA and ASAP do not proactively evaluate the nuances of crew interpersonal skills; their insights into CRM efficacy are contingent upon events where safety thresholds are compromised, and risk is escalated. These programs may offer data indicative of CRM effectiveness, yet there is no explicit mandate for such evaluation within their protocols. LOSA aims to document aviator conduct under standard operational conditions, yet the integrity of the data may be compromised by two prevalent human characteristics: the modification of behavior under observation, known as the Hawthorne effect (McCambridge, Witton, & Elbourne, 2014), and the potential introduction of observer bias, which can infuse subjectivity into what is intended to be objective data. Despite these limitations, these systems have contributed to the enhancement of aviation safety, providing valuable insights that inform and potentially shape future training curricula. Nonetheless, a significant gap remains in their capacity to directly enhance the interpersonal skills of flight crew members; rather, these systems could be used as tools and metrics for evaluating the success of future advanced interpersonal skills training.

2.5 Quantifying Interpersonal: ICAO & IATA Pilot Competencies

The International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) endorse a competency-based approach for the assessment of pilots, focusing on observable behaviors (OBs) as indicators of proficiency within essential operational domains. ICAO delineates eight core competencies: adherence to procedures and regulations, communication, both automated and manual aeroplane flight path management, leadership, and teamwork, problem-solving and decision-making, situational awareness, and workload management (International Civil Aviation Organization). IATA reflects ICAO's recommendations but also incorporates an additional competency: "application of knowledge" (International Air Transport Association, 2023, p. 30).

These OBs are critical to effective Crew Resource Management (CRM) and to safety voice, as they directly influence the operational environment by mitigating threats, managing errors, and enhancing overall safety through improved performance and decision-making processes.

Table 2.5 details the IATA OBs for Communication (OB2) and Leadership and Teamwork (OB5)—two OBs that are highly pertinent to interpersonal skills within the flight deck.

Table 2.5
ICAO & IATA Observable Behaviors for Communication and Leadership and Teamwork Pilot Competencies

Communication Communicates through appropriate means in the operational environment, in both normal and non normal situations.	OB 2.1 Determines that the recipient is ready and able to receive information OB 2.2 Selects appropriately what, when, how and with whom to communicate OB 2.3 Conveys messages clearly, accurately and concisely OB 2.4 Confirms that the recipient demonstrates understanding of important information OB 2.5 Listens actively and demonstrates understanding when receiving information OB 2.6 Asks relevant and effective questions OB 2.7 Uses appropriate escalation in communication to resolve identified deviations OB 2.8 Uses and interprets non-verbal communication in a manner appropriate to the organizational and social culture OB 2.9 Adheres to standard radiotelephone phraseology and procedures OB 2.10 Accurately reads, interprets, constructs and responds to datalink messages in English
Leadership and Teamwork Influences others to contribute to a shared purpose Collaborates to accomplish the goals of the team.	OB 5.1 Encourages team participation and open communication OB 5.2 Demonstrates initiative and provides direction when required OB 5.3 Engages others in planning OB 5.4 Considers inputs from others OB 5.5 Gives and receives feedback constructively OB 5.6 Addresses and resolves conflicts and disagreements in a constructive manner OB 5.7 Exercises decisive leadership when required OB 5.8 Accepts responsibility for decisions and actions OB 5.9 Carries out instructions when directed OB 5.10 Applies effective intervention strategies to resolve identified deviations OB 5.11 Manages cultural and language challenges, as applicable

(International Air Transport Association, 2023, pp. 30-35)

In the domain of aviation safety, effective communication (OB2) is paramount, serving as a cornerstone for both Crew Resource Management (CRM) and Threat and Error Management (TEM). This entails a suite of Observable Behaviors (OBs) that include ensuring the readiness and capacity of the recipient to assimilate information, selecting the appropriate content, timing, and modality of communication, and the clarity, accuracy, and brevity of message delivery. Confirming the recipient's comprehension and engaging in active listening reinforce mutual understanding, while the ability to pose pertinent questions and escalate communication tactically to address deviations enhances collaborative problem-solving.

In Leadership and Teamwork (OB5), the ability of individuals to inspire collective action toward a shared objective is essential. This includes encouraging active participation and transparent communication, demonstrating leadership, providing direction, fostering inclusive planning, valuing team input, and the constructive exchange of feedback. Effective conflict resolution, decisive action when necessary, accepting responsibility, and compliance with directives further encompass the

leadership category. Additionally, leaders must adeptly manage deviations through strategic interventions and navigate cultural and linguistic complexities. Together, these behaviors activate the safety voice, a critical element for identifying and mitigating risks proactively, thereby underpinning a more robust CRM and TEM framework. This activation contributes significantly to risk reduction in aviation.

The Observable Behaviors (OBs) outlined for communication and leadership within Crew Resource Management (CRM) and Threat and Error Management (TEM) frameworks may not be adequately trained due to various systemic and institutional limitations. It is one thing to require certain OBs but another to offer the training that sufficiently teaches how to generate these OBs innately through SOPs and continuously throughout the operations.

Training programs may not sufficiently simulate the complexities of real-world operational environments, where high-stress situations and dynamic challenges require nuanced application of these OBs. For example, the subtleties of non-verbal communication (OB 2.8) or the escalation of communication to resolve flight deviations (OB 2.7) demand context-specific understanding and real-time adaptability that may not be fully captured in standard training scenarios.

Additionally, CRM and TEM training may be limited in scope, focusing predominantly on basic expectations of communication and collaboration rather than more advanced interpersonal skills such as active listening (OB 2.5) and effective feedback exchange (OB 5.5). The depth of interpersonal skills training required to address and resolve conflicts constructively (OB 5.6) or to manage cultural and language challenges (OB 5.11) may be insufficient.

To address these gaps, aviation training programs need to adopt a more holistic approach that integrates OBs into all aspects of training, ensuring that behavioral competencies are developed alongside technical skills. This can include the use of advanced interpersonal skills in classroom training, advanced simulation technologies, scenario-based training that mirrors the complexity of real-world operations, and an organizational culture that values and reinforces the continuous practice and assessment of these critical behaviors.

2.6 Quantifying Interpersonal: The FAA’s Behavioral Markers

Appendix 1 of the Federal Aviation Administration's Crew Resource Management Advisory Circular (FAA, 2004) contains a comprehensive suite of behavioral markers, which are intended to aid organizations in the development of programs and curricula, as well as to provide a framework for feedback. However, the FAA explicitly cautions that these markers should not be utilized as a definitive checklist for the assessment of individual crew members' performance (see Appendix 1 of Federal Aviation Administration, 2004).

Table 2.6 presents a selection of these FAA behavioral markers, which will be examined in greater depth within Chapter 4 and referenced in conjunction with the analysis presented in Chapter 7. This initial presentation serves as an introductory cross-reference to the ensuing discourse. It is important to note that the enumeration in Table 2.6 is not comprehensive and is organized for ease of reference by adopting a

nomenclature akin to that of the ICAO and IATA standards, diverging from the original cataloging in the FAA document.

Table 2.6
A Non-exhaustive List of FAA Behavioral Markers for Crew Performance

COMMUNICATIONS PROCESSES AND DECISION BEHAVIOR CLUSTER (CP)	CP1. The captain's briefing establishes an environment for open/interactive communications (e.g., the captain calls for questions or comments, answers questions directly, listens with patience, does not interrupt or "talk over," does not rush through the briefing, and makes eye contact as appropriate).
	CP2. The briefing establishes a "team concept" (e.g., the captain uses "we" language, encourages all to participate and to help with the flight).
	CP3. Crewmembers speak up and state their information with appropriate persistence until there is some clear resolution.
	CP4. Questions are encouraged and are answered openly and nondefensively.
	CP5. Crewmembers are encouraged to question the actions and decisions of others.
	CP6. Crewmembers seek help from others when necessary.
	CP7. Critique makes a positive learning experience. Feedback is specific, objective, usable, and constructively given.
	CP8. Crewmembers are encouraged to state their own ideas, opinions, and recommendations.
	CP9. Efforts are made to provide an atmosphere that invites open and free communications.
TEAM BUILDING AND MAINTENANCE CLUSTER (TB)	TB1. Group climate appropriate to the operational situation is continually monitored and adjusted (e.g., social conversation may occur during low workload, but not high).
	TB2. Crewmembers show sensitivity and ability to adapt to the personalities of others.
	TB3. Crewmembers recognize symptoms of psychological stress and fatigue in self and in others (e.g., recognizes when he/she is experiencing "tunnel vision" and seeks help from the team; or notes when a crewmember is not communicating and draws him/her back into the team).

	TB4. “Tone” in the cockpit is friendly, relaxed, and supportive.
	TB5. During times of low communication, crewmembers check in with others to see how they are doing.
WORKLOAD MANAGEMENT AND SITUATION AWARENESS CLUSTER (WM)	WM1. Avoiding “tunnel vision” caused by stress (e.g., stating or asking for the “big picture”).
	WM2. Being aware of factors such as stress that can degrade vigilance and watching for performance degradation in other crewmembers.
	WM3. Crewmembers speak up when they recognize work overloads in themselves or in others.
	WM4. Nonoperational factors such as social interaction are not allowed to interfere with duties.

Appendix 1 AC 120-51E (Federal Aviation Administration, 2004)

As noted in the preceding subsection, the Federal Aviation Administration (FAA), as of the year 2022, mandates that airline captains partake in specialized training focusing on leadership and command (Federal Aviation Administration, 2020). The pertinent Advisory Circular regarding this regulation diverges from Crew Resource Management (CRM) guidelines in that it does not specify distinct behavioral markers to gauge effective leadership. Nevertheless, it conceptualizes leadership within the aviation context as a relational dynamic, highlighting the necessity for the pilot in command (PIC) to engage proactively and reactively with crew members, incorporating flight attendants where relevant, and to leverage all accessible resources to navigate the aircraft safely and professionally in alignment with Standard Operating Procedures (SOPs).

Further, the FAA defines characteristics indicative of proficient leadership, enumerating traits such as confidence, concentration, decisiveness, adaptability, accountability, integrity, professionalism, and the capacity to motivate others. In subsequent sections of this thesis, the criteria set forth by the FAA will be critically examined in parallel with empirical data drawn from the experiential accounts of professional aviators, thereby shedding light on the practical implications of these regulatory expectations.

2.7 Chapter Conclusion

This chapter provided a comprehensive analysis of the evolution of national safety regulations, focusing on the interaction between global standards set by ICAO and their adoption by bodies like the FAA. It emphasized the influence of legislative bodies such as Congress, particularly in response to incidents like the Colgan Air crash

of 2009. External organizations like IATA and ALPA, who also play a critical role in the regulatory process, were introduced.

The chapter also examined ICAO and IATA expectations regarding pilot competencies, particularly interpersonal skills, and categorizes the FAA's crew performance behavioral markers for ease of reference. It highlighted the dynamic nature of aviation safety models, evolving through academic research and legislative influence. This understanding forms the basis for the recommendations proposed in the thesis, representing the next phase in CRM training evolution.

Chapter 2 aimed to emphasize the evolving nature of CRM training, often driven by reactive responses. The following chapter lays crucial groundwork by introducing social psychological concepts, paving the way for future revisions of CRM to transition into a proactive process for its next iteration.

Chapter 3 - Related Literature: Safety Voice

3.1 Chapter Overview

This chapter discusses safety voice activation, synthesizing prior research including contributions from diverse academic fields. It conceptualizes the flight deck as a sociotechnical system, drawing on theories from social and organizational psychology to illuminate ways to enhance aviation safety by focusing on its inherent social dynamics. We quantify the phenomena of subdued safety voice and safety silence, utilizing these constructs as a theoretical foundation to advocate for a reformed paradigm of CRM/TEM training. We contend that new training content should encompass psychological safety, bias awareness, and effective communication, aspects currently underrepresented in pilot training programs. Lessons from social and organizational psychology can inform the refinement of future iterations of CRM/TEM training.

3.2 Lessons from Social and Organizational Psychology

Aviators constitute a distinctive dyadic pairing, specifically the Captain and First Officer, who function under conditions that are distinct from conventional co-working dyads. Ordinarily, the flight deck is occupied by just two pilots (on longer flights there may be three or four pilots), positioned approximately three to four feet apart—a distance that varies according to the design specifications of the aircraft manufacturer. The following subsections employ a framework from social and organizational psychology and behavioral science to explore the constructs that may influence the dynamics of flight crew interactions, such as culture, psychological safety, bias literacy, interpersonal communication, power dynamics, theories of distributed cognition, and resilience.

Post-September 11, 2001, modifications to flight deck access policies have resulted in the flight deck doors remaining secured during flight, effectively isolating the pilots in a confined space that, while offering panoramic aerial views, can be likened to an enclosed office with stringent entry controls. This dyadic relationship, situated within a dynamic operational context, is unique. Crew coordination is intricately linked to the successful implementation of Crew Resource Management (CRM) and Threat and Error Management (TEM) paradigms, which in turn are contingent upon the establishment of a positive microculture.

3.2.1 Culture

The word “culture” has become an umbrella term whose definition has used in different ways by various academic disciplines. Anthropologists, for example, might discuss culture through the lens of relativism, examining geographically bound tribes’ actions and beliefs by contrasting them with adjacent groups. Sociologists may view

culture more in terms of symbolic codes (visual, auditory, or behavioral cues that convey meaning) to identify individuals as belonging to one particular group and not another. In organizations, a “culture” can be said to exist when key assumptions and attitudes are consistent and define how a majority of the members of the organization behave (Bellot, 2011). It is a broad term that allows the concept to remain both malleable and nuanced.

In social psychology, we can use the term to better understand behavior, as in this definition of culture: “a loosely integrated system of ideas, practices, and social institutions that enable coordination of behavior” (Morris, Chiu, & Liu, 2015, p. 632). For our purpose, which is to discuss aviation culture within the flight deck, the paper adopts the broad definition of culture as the ideas, beliefs, and assumptions that organize a group’s behavior (Markus & Hamedani, 2019).

Cultural dynamics can be discerned, experienced, and interpreted across a continuum of analytical scopes, ranging from expansive, macro-level perspectives, such as those encompassing national characteristics, to the nuanced, micro-level viewpoints relevant to smaller collectives, including team-based interactions within organizations or interpersonal relations within the dyadic relationship such as those within the flight deck.

An individual’s behavior is highly situational and may be subject to the influence of various strata of cultural norms (Markus & Hamedani, 2019). For instance, women may navigate the expectations of a national culture that prescribes certain behaviors based on gender roles. These prescribed behaviors may be in opposition with the professional norms of an institutional culture, such as those within the aviation sector, which uphold distinct behavioral expectations for pilots. It is, therefore, imperative to dissect aviation culture through an institutional and systemic framework, hereafter referred to as 'industry culture'. This stands in contrast to the dynamics within the flight deck, often consisting of a two-pilot team, and expanding to three or four members during augmented crew operations, a setting that will be identified as 'microculture' in the context of the majority of United States air carrier operations.

Researchers Markus and Hamedani (2019) argue that culture is cyclic; that is, individuals both influence culture and are influenced by culture. Although this dissertation does not examine individuals’ beliefs and behaviors, it undertakes an examination of the intricate interplay among different strata of culture. I discuss aviation culture from both a macroscopic viewpoint, considering the industry's overarching dynamics and the archetype of the ideal pilot image, and a microscopic lens, focusing on the microculture within the flight deck. These different levels of culture interact with and influence each other.

3.2.2 Psychological Safety in the Flight Deck

A critical assumption in both the larger organizational safety model (Safety Management System) and the flight deck models (Crew Resource Management and Threat and Error Management) is that safety relies on individuals sharing safety-sensitive information. Both the macro view of the organizational safety culture and the flight deck microculture expect individuals to speak up. As we explored in Chapter 2, CRM focuses on crew communication and the sharing of safety-sensitive information.

Crew communication, in terms of safety-sensitive information, can be broken down into four categories: safety voice (speaking up), safety listening (actively listening to safety concerns), muted safety voice (speaking in a passive or hushed way), and safety silence (remaining silent regarding safety) (Bienefeld & Grote, 2014; Noort, Reader, & Gillespie, 2021). Table 3.2.2 offers an overview of these forms of safety communication.

Table 3.2.2
Types of Safety Communication

Types of Safety Communication	
Safety voice	Speaking up and sharing safety information
Safety listening	Actively listening for safety concerns
Muted Safety Voice	Speaking in a passive or hushed way or rephrasing concerns as a question.
Safety Silence	Remaining silent and withholding information.

These categorizations establish a basis for interrogating the foundational presumptions of the system's design, allowing a re-examination of the fundamental tenets underpinning Crew Resource Management (CRM) protocols and the anticipated outcomes of the system.

Various social psychology and behavioral science theories and phenomena have been used to analyze safety voice (Edmondson, 1999; O'Donovan & McAuliffe, 2020). A set of researchers explored power distance (the extent to which a society accepts that power is distributed unequally (Hofstede, 1980) as a moderator for flight deck safety voice; and, found that Crew Resource Management enhanced safety voice but mainly for low power distance flight decks (Noort, Reader, & Gillespie, 2021).

A scholarly inquiry conducted by Bienefeld and Grote (2014) examined the role of hierarchical status as a potential moderating factor influencing the expression of safety concerns within aviation crews. Their empirical research, encompassing a sample of 1,751 crew members, indicated that First Officers were often hesitant to vocalize issues due to apprehensions about jeopardizing the rapport with the Captain or being perceived as 'negative' (p. 6.). The study's findings underscore that across all ranks—Captains, First Officers, and Flight Attendants—there was a pervasive concern that the act of speaking up might erode interpersonal trust and acceptance within the crew (p. 7) (Bienefeld & Grote, 2014).

Individuals may avoid asking for help or admitting mistakes as a way to preserve their dignity or reputation and avoid embarrassment (to save face) (Edmondson, 1999; Chater & Gittell, 2009; Gruman & Saks, 2014) even when speaking up might benefit the group.

Image cost research (Catalano, Redford, Margoluis, & Knight, 2017) has established that people value their image and, therefore, are alert to and abide by social

expectations to avoid embarrassment. Individuals may feel uncomfortable sharing mistakes because admitting an error may be perceived as incompetence. When the risk of threat or embarrassment is high, people tend to act in ways that inhibit learning from failures by remaining silent (safety silence). In order to circumnavigate this self-silencing, the team environment must be comfortable for interpersonal risk-taking (Edmondson, 1999), a team phenomenon known as *psychological safety*.

Much academic research has been conducted with a focus on team dynamics (Grant & Ashford, 2008; Driskell, Salas, & Driskell, 2018) but one term is critical in evaluating safety communication. Popularized in 1999 by Dr. Amy Edmondson, the term *psychological safety* has advanced to mean “a shared belief that the team is safe for interpersonal risk taking” (p. 354). This means team members can engage through sharing ideas, admitting mistakes, and asking for help without fear of negative consequences or punitive retribution. Psychological safety creates a culture where team members feel respected and valued, even when sharing dissenting opinions.

To better understand psychological safety, this thesis explores what it is not. It is not team cohesion, nor is it “being nice.” Team cohesion is a condition where it may appear that everyone gets along, but, in actuality, team members are self-silencing as a method of “keeping the peace” or “saving face” (Edmondson, 1999; Bienefeld and Grote, 2012; Edmondson, 2019). Similarly, it is not about being nice. Rather, it is about candor and a willingness to engage in productive debate as an opportunity to learn from one another (Edmondson, 2019).

When the flight deck microculture generates psychological safety, crew members can engage in interpersonal risk-taking, such as individuals saying, “I don’t know” (Rosenbaum, 2019) reporting errors (Leroy et al., 2012), and learning from failure (Carmeli & Gittell, 2009). Responses like these are essential elements of both Crew Resource Management (CRM) and Threat and Error Management (TEM). They are facets of psychological safety and are not theoretical abstracts; they have been observed, both their absence and their presence, in the aviation industry in recent academic research (Perkins et al., 2022).

In the Crew Resource Management/Threat and Error Management (CRM/TEM) paradigm, there is an explicit expectation that First Officers articulate concerns; nonetheless, this mandate does not encompass the elements of psychological safety within the complexities of crew interactions. Absent the foundational element of psychological safety, the functional integrity and effectiveness of the CRM/TEM framework is substantially compromised.

The existing model was constructed under the presumption of the ubiquitous presence of psychological safety within the aircraft's flight deck, a false premise that accentuates operational risk. An augmentation of this model could be achieved through the implementation of leadership training, specifically targeting individuals of higher status in the flight deck, such as Captains, with the objective of cultivating psychological safety within the flight deck environment. This proactive approach seeks to fortify the model's efficacy by shifting the reliance away from the assumption that First Officers will invariably disclose safety-sensitive information.

Comprehending the significance of establishing psychological safety constitutes a pivotal stride toward augmenting the effectiveness of Crew Resource

Management/Threat and Error Management (CRM/TEM). Spreading awareness about psychological safety doesn't guarantee its existence. Thus, it's crucial to explore various factors that shape its presence or absence in the flight deck microculture. While psychological safety is a collective concept, the following section focuses on individual processes that can hinder the team's ability to cultivate this environment.

3.2.3 Bias Literacy

The following subsection is an extraction of previous research I conducted with colleagues (Perkins, Hall, Ghosh, 2024).

As human beings, we all hold individual opinions and biases that shape the ways in which we make sense of the world around us. Biases are not necessarily negative; they are altogether unavoidable (Ross, 2020) and form an integral part of group dynamics. Humans create social categories (including race, age, gender, religion nationality, and socioeconomic status, or class), derive identity from these categories and use them to form groups, and then gain a sense of belonging from group membership (Tajfel, Social identity and intergroup behaviour, 1974). People are likely to be more positively disposed toward others they perceive to be similar to them, i.e. in their in-group, as opposed to someone they perceive to be in their out-group (Greenwald & Banaji, 1995). This sense of belonging produces intergroup and intragroup emotions that direct behavior.

This phenomenon is an important subset to enhancing CRM as it informs behavior that can contribute to or distract from creating a flight deck microculture conducive for the development of psychological safety. This is especially important because pilots might find themselves sharing the space with others either in their in-groups or out-groups, which might subconsciously dictate how they interact. Therefore, it warrants discussion on how individual biases and in-group/out-group membership affects the culture and should be explored within CRM training.

Within FAA Advisory Circular 120-51E, discussions of bias and intergroup theory are not well explored. Such topics are tangentially referenced within Curriculum Topic b-2 (p. 12) under “Interpersonal Relationships/Group Climate” which refers to setting tones (emotional and attitudinal qualities) of conversation within the flight deck. There are other discussions on external factors for decision-making (Topic a-5, p. 11) and communication barriers due to aspects of identity such as racial or gender differences (Topic a-1, p. 10) (Federal Aviation Administration, 2004). However, we maintain (a) that while these discussions begin to touch upon discussions of bias and the importance of recognizing personal biases, they do not go far enough, and (b) we define “bias literacy” within the CRM setting as *the recognition of one’s own explicit and implicit biases; the cognitive, affective, and behavioral manifestation of bias; and the impact of such biases on interpersonal communication.*

If policy aims to address intragroup behavior, as CRM training does, it must provide education on intragroup and intergroup emotion and provide actionable ways to operationalize collaborative engagement, which could be facilitated through bias literacy.

The presented discourse underscores the paramount importance of understanding individual opinions and biases in human interactions. These biases, while not inherently negative, are an inescapable facet of human cognition and are intricately woven into the tapestry of group dynamics. The process by which humans categorize themselves and others based on various social identifiers and subsequently derive a sense of belonging from these categories is a fundamental aspect of social psychology.

The relevance of this phenomenon becomes pronounced in the context of Crew Resource Management (CRM) as it directly informs behavior that can either foster or hinder the development of a flight deck microculture conducive to psychological safety. In the aviation industry, where pilots often share space with individuals from diverse backgrounds, individual biases and in-group/out-group dynamics can subconsciously influence interactions. Thus, it is imperative to explore how these biases and group dynamics impact the culture within CRM training.

The existing FAA Advisory Circular 120-51E provides some insight into interpersonal relationships and group climate but falls short in adequately addressing bias-related issues. Therefore, we argue for the concept of "bias literacy" within CRM, which entails recognizing one's explicit and implicit biases, understanding their cognitive, affective, and behavioral manifestations, and acknowledging their impact on interpersonal communication. To effectively address intragroup behavior and promote collaborative engagement, CRM training should incorporate bias literacy as a means to operationalize inclusive and effective teamwork.

3.2.4 Interpersonal Communication

As highlighted in section 3.2.2, prior research (Conchie, Taylor, & Donald, 2012; Bienefeld & Grote, 2014; Noort, Reader, & Gillespie, 2021) has demonstrated an inseparable link between safety voice and the overall safety of the aircraft. The tools provided to pilots in creating a microculture conducive to a safety voice are those recommended by the FAA in AC 120-51E Crew Resource Management Training.

Within the AC, the word “interpersonal” is mentioned eleven times across twenty-five pages. It is referenced in terms of activities (p. 2), relations or relationships (p. 8 and 11), problems, issues, and communication (p. 10 and 12) (Federal Aviation Administration, 2004). However, it is never defined.

The CRM AC highlights the importance of communication, as seen in the following: “A central CRM concept is communication” (p. 7). To this end, we maintain it is important to elicit a deeper understanding of what interpersonal communication is and how it differs from other styles of communication, such as impersonal communication.

While the FAA does not define interpersonal communication, it does offer behavioral markers indicating acceptable communication processes, such as “Crewmembers speak up and state their information with appropriate persistence until there is some clear resolution” (CP3) (see Chapter 2, Table 2.6). We can glean insight into a definition of interpersonal communication by turning toward academic research and grounding our own definition in aviation literature.

Interpersonal communication, as conceptualized through various academic frameworks (Babrow & Striley, 2014), involves voluntary interaction between independent parties with the intent of interpreting messages (Galvin & Cooper, 2003) and generating meaning (Braithwaite & Schrodt, 2014).

While the FAA Advisory Circulars do not explicitly define interpersonal communication, behavioral markers indicative of quality interpersonal relationships imply a requirement for pilots to recognize and adapt to each other's personalities and states of mind (FAA, 2004) and emphasizes the need for pilots in command to adapt their leadership styles to varying crewmember attributes and experiences (FAA, 2020). These behavioral markers are representative of the definition derived from academic work. Interpersonal communication, can therefore, be defined as: *the exchange of social or emotional messages between persons that relies on a shared or mutual understanding of each individual* (Perkins, Hall, Ghosh, 2024).

In contrast, *impersonal* (as opposed to *interpersonal)* communication within the flight deck consists of functional interactions necessary for aircraft operation but does not significantly contribute to relationship development between pilots (Galvin & Cooper, 2003). These interactions, such as checklist reading and standard briefings, are highly formalized and standardized, often trained throughout pilot programs. They are necessary to accomplish the mission but do little to build psychological safety.

It is interpersonal communication that plays a pivotal role in fostering trust and psychological safety within the flight deck microculture. The transition from impersonal to interpersonal communication can either facilitate the development of safety voice or, conversely, trigger safety silence when communication falters (Perkins, Hall, Ghosh, 2024).

3.2.4.1 Interpersonal Communication in Action

While impersonal communication is a necessary function of operating the aircraft (e.g., checklist reading, briefings, etc.), it lacks the relational necessity to see the recipient of the communication as a unique individual. Therefore, I argue it is an ineffective tool to generate psychological safety. Conversely, interpersonal communication serves as a tool to beget safety voice through the production of psychological safety within the flight deck microculture.

Previous research (Perkins et al., 2022) found that a significant proportion of both First Officers and Captains (reflecting on their time as a First Officer) have experienced instances where they hesitated to speak up about safety due to a negative tone established by the Captain. Specifically, 77% of First Officers and 75% of Captains reported such experiences. Additionally, the research examined the phenomenon of safety silence and found that 43% of pilots surveyed admitted to participating in safety silence, withholding safety-sensitive information due to a negative flight deck microculture established by the Captain. Importantly, the research highlighted that it was poor interpersonal communication rather than impersonal communication that contributed to this negative tone.

The findings from the research by Perkins et al. (2022) suggest that a significant proportion of First Officers and Captains (reflecting on their time as First Officers)

experience hesitation to voice safety concerns due to the negative tone set by the Captain. This hesitation, which leads to what is termed 'safety silence,' is a critical factor that increases risk and decreases safety.

The study's findings highlight the importance of interpersonal communication in establishing a positive flight deck microculture. It underscores the need for Captains to foster an environment where safety can be discussed openly and without negative repercussions. This is vital for maintaining high safety standards and minimizing risk in aviation operations.

First Officers expressed feeling undervalued, micromanaged, and uncomfortable by Captains on the flight deck, often treated as though they lacked competence and needed excessive direction. This sentiment was echoed in comments such as, “Don’t act like I have to be taught how to fly again, just because I am a FO” (pg. 7) and “Allow me to do my job” (pg. 8) (Perkins et al., 2022).

Many comments highlighted instances of disrespect and infantilization, emphasizing the need for trust and autonomy in their roles. Additionally, some First Officers reported discomfort due to misogynistic and offensive comments made by Captains. First Officers suggested that Captains should refrain from being “a cocky jerk.” And, that they should not “make misogynistic jokes.”; “Don’t bring gender bias in the cockpit”; and “Stop berating women and gays.” (Perkins et al., 2022, pg. 8). Such comments make it difficult for First Officers to focus on doing their jobs to the best of their abilities since they have to expend cognitive energy processing (Salvatore and Shelton, 2007) or feel stigmatized by the comments (Pinel, 1999).

These experiences underscore the critical importance of effective interpersonal communication in fostering a positive flight deck culture and activating the 'safety voice.' When Captains create an environment that respects the professionalism and dignity of all crew members, it encourages open dialogue and empowers individuals to voice safety concerns without fear of repercussion. Captains thus play a vital role in shaping a microculture that prioritizes safety, dialogue, and mutual respect among crew members.

3.2.5 Power

Since the implementation of Crew Resource Management (CRM) protocols, there has been a notable enhancement in the articulation of safety concerns within the flight deck, particularly within aviation organizations situated in nations characterized by a lower index of power distance (Noort et al., 2020). This progression reflects the influence of national cultural dimensions on operational behavior. However, the scope of this thesis extends beyond the realm of national culture to a more granular analysis of how institutional and social constructs of power influence and shape the dynamics of safety communication within flight deck hierarchies.

Power, a concept with varied definitions across different academic disciplines, is herein adopted in its multidisciplinary and expansive sense as the capacity to exert influence over the allocation of resources or determination of outcomes. More specifically, power is “any control over any resources or outcomes” (Chugh, 2018, p. 99).

With this framework, the discourse progresses to an institutional examination of power as it manifests within the structured hierarchy of aviation—specifically, the roles of Captain versus First Officer. This exploration is undertaken in the ensuing paragraphs. Concurrently, the social aspect of power is interrogated through the lens of demographic majorities and the dynamics between in-groups and out-groups, a topic that is the focal point of the chapter that follows.

Subsequent to the National Transportation Safety Board's (NTSB) determination that unprofessional conduct and deficient leadership significantly contributed to several aviation mishaps in the early 2000s (refer to Northwest Airlink Flight 3701, a Corporate Airlines BAE Systems BAE-J3201, Continental Connection Flight 3407), the Federal Aviation Administration (FAA) intensified its focus on leadership training mandates for all air carriers within the United States (Federal Aviation Administration, 2020). Within their revised training directives, the FAA advocates for a leadership approach that is responsive to the dynamics of the flight crew, advising leaders to modify their leadership styles in consideration of their fellow crew members' perspectives (p. 6). This emphasis on adaptability, though highlighted in the new guidance, is not an unprecedented concept within the domain of the FAA. Predating this by sixteen years, similar principles were encapsulated in the CRM Advisory Circular, which stipulates a requirement for aviators to demonstrate their ability to ‘show sensitivity’ toward other crew members’ thinking and personality styles (see Chapter 2).

Recognizing the critical role that individuals in positions of authority play in promoting a culture of safety communication—particularly Captains on the flight deck—this investigation was designed to ascertain the value placed on interpersonal skills within the context of effective Crew Resource Management (CRM) and Threat and Error Management (TEM). The relevance of such competencies formed a pivotal element of the central research questions, which are examined in detail in subsequent chapters of this dissertation. Prior to this investigative endeavor, preliminary inquiries into this domain were conducted in collaboration with researchers Dr. Crystal Hall and Sourojit Ghosh. This preliminary research focused on one aspect of interpersonal skills as advocated by the Federal Aviation Administration—namely, 'showing sensitivity'—to elicit perceptions from Captains regarding the importance of this CRM behavioral indicator in the maintenance of safety.

Research conducted in 2021 has yielded interesting insights into relative power and the perceived value of certain interpersonal skills to enhance safety (Perkins, Hall, Ghosh, 2024). The study consisted of leveraging various social media platforms and pilot-specific groups, resulting in 822 individual responses to a 34-question survey from active industry pilots globally. The survey covered aspects ranging from pilot experience and demographics to CRM training, crew dynamics, and pilots’ perspectives across Hofstede’s (1980) cultural dimensions.

The research examined professional pilots' views on the necessity of demonstrating sensitivity in CRM training, as outlined by FAA AC120-51E. Results showed that 51% of respondents had not encountered this aspect in their CRM training, while 49% reported its inclusion.

Subsequently, pilots were surveyed on whether they believed demonstrating sensitivity could improve safety within CRM. While the study did not delve into analyzing these responses, the data collected provided valuable insights.
Responses from 815 pilots revealed that nearly half (49.4%) believed demonstrating sensitivity would enhance safety, while 35.5% thought it might, and 15.1% did not believe it would.

Considering power dynamics, the study explored institutional hierarchy (Captain vs. First Officer) and social demographics (gender), highlighting their influence on safety attitudes. Analysis indicated that individuals with lower institutional and social power were more likely to endorse the safety-enhancing potential of sensitivity demonstration, contrasting with those with higher power.

Subsequently, the negative responses (N=123) regarding the correlation between demonstrating sensitivity and enhancing safety were analyzed across two variables: pilot rank (Captain vs. First Officer) and gender (female vs. male). The survey findings revealed that individuals with lower relative power, such as First Officers and females, were more inclined to perceive a connection between demonstrating sensitivity and improving safety. In contrast, those with higher relative power, namely Captains and males, demonstrated less recognition of this link. Table 3.2.5 shows the variable breakdown for those responding No to the survey question. A statistical analysis, outlined in Appendix A, demonstrated statistical significance regarding the social power variable (i.e., gender), with a p-value below 0.00001.

Table 3.2.5
Beliefs on Sensitivity Enhancing Safety by Power Variables: Responses to Survey Question

	First Officer	Captain	Female	Male
yes	64%	47%	64%	47%
maybe	26%	37%	29%	37%
no	11%	16%	7%	17%

The findings of this study reveal a notable challenge among pilots with higher relative power in recognizing sensitivity as a key component of safety enhancement, as advocated by the FAA within the context of advanced Crew Resource Management (CRM)/Threat and Error Management (TEM). This thesis aims to explore the correlation between relative power and the acknowledgment or endorsement of interpersonal skills in forthcoming chapters. This research underscores the importance of addressing potential disparities in safety perceptions and attitudes, particularly concerning the relevance of interpersonal skills among Captains. We address this in more detail in section 3.3.3.1 where we infer a specific correlation between interpersonal skills and safety violations.

These findings have practical implications for Crew Resource Management (CRM) training, highlighting the necessity of emphasizing interpersonal skills, including sensitivity and effective communication, especially for individuals in positions of higher

institutional or social power. Addressing these power dynamics can pave the way for a more egalitarian safety environment within the aviation industry, where safety is recognized as a collective responsibility transcending rank or social groups. By acknowledging and mitigating differing perceptions of safety influenced by power dynamics, the industry can enhance safety outcomes by ensuring all crew members comprehend the pivotal role of interpersonal sensitivity in fostering a safe flying environment. This research underscores the multifaceted nature of human factors in aviation safety, emphasizing the significance of considering psychological and sociological elements to improve safety outcomes.

3.3 Sociotechnical Systems & Distributed Cognition Theory

Within the scope of this thesis, two scholarly theories are examined in depth to unpack the intricacies of the dyadic relationships within the microculture of the flight deck. The first, sociotechnical systems theory, serves as a lens through which the interplay of social processes, such as crew interactions, and technological interfaces, such as the operational systems of the aircraft, can be comprehended. The second theoretical framework, distributed cognition, provides a structure for understanding how knowledge and cognitive processes are shared and distributed between individuals and technological artifacts in the flight deck. Together, these frameworks facilitate a nuanced analysis of the bidirectional relationship: the social (the interpersonal dynamics among flight crew members) and the technological (the engagement with aviation technology), elucidating how information processing and exchange within this domain is a collective cognitive endeavor.

This subsection will examine how the health of the socio-processes impact the overall health of the sociotechnical system by analyzing ways in which a reduction of efficacy in the CRM/TEM model disrupts distributed cognition (that is, knowledge, thought processes, decision-making when not confined solely within individual minds but as distributed among crew members and aircraft technology) in the sociotechnical system of the flight deck.

3.3.1 Sociotechnical System

While research is carried out for a variety of reasons, one of its aims is to understand people’s actions and/or inaction within their working environments (Kyriadkidis, Majumdar, & Ochieng, 2018). The research for this thesis provides a framework for understanding the interdependency between the processes of a social system (e.g., pilot to pilot interaction) and technology (e.g., flight deck, aircraft) (Carayon, 2006). Through this lens, I offer an analytical framework to scrutinize the impact of socio processes, such as pilot-to-pilot interactions, on the capacity to operate aviation technology effectively. This framework recognizes that the operations within the flight deck are not solely dependent on the mechanical and electronic functionality of the aircraft's systems but are also profoundly influenced by the quality of communication, coordination, and collaboration among the flight crew (Carayon et al., 2015).

I explored this conceptual framework in detail in previous work conducted with Dr. Crystal Hall and Sourojit Ghosh. The remaining paragraphs of this subsection are excerpted from the journal article previously discussed, “Interpersonal Skills in a Sociotechnical System: A Training Gap in Flight Decks” (2024) in the *Journal of Aviation/Aerospace Education & Research*.

The concept of a sociotechnical system emerged as the world shifted from assembly-line manufacturing to modernity’s necessity of manufacturing cognitive skills. The safe and efficient functioning of many complex systems is a harmonic operation of several technological, social, and human factors. Such a conception of work environments, known as sociotechnical systems (STS), was proposed by Geoffrey Bowker (Bowker, Star, Gasser, & Turner, 1997) and has since been developed to provide a conceptual framework for the interdependency of technological (e.g., machine, equipment, tools, etc.) and social processes (e.g., individuals comprising a team, the necessity to coordinate, crew collaboration, etc.) (Carayon, 2006; Carayon et al., 2015).

A flight deck is a sociotechnical system, comprised of advanced flight deck technology and integrated avionics systems as the technical part while the pilots (Haavik, Kongsvik, Bye, Dalseth Royrvik, & Almklov, 2017) (and flight attendants, ramp employees, Air Traffic Controllers, dispatchers, gate agents, where applicable) encompass the social aspect of the system. As such, any understanding of the safe and effective functioning of flight decks through an STS lens must operate along both parts of the system. This is especially true when analyzing accidents, and the importance of social and human factors on the flight deck in preventing future accidents.

STS provided a much-needed development in safety management because major accidents (e.g., Space Shuttle Challenger and the 737 MAX design) demonstrated the need to better understand and train on the systemic causes of accidents in safety-critical environments (Swuste et al., 2020). In particular, prevailing human factors explanations tended to over-simplify technological and individual aspects as detached and a-social processes (Ropohl, 1999).

To address the social and dynamic nature of accidents, STS has inspired training programs in aviation such as Crew Resource Management (Helmreich & Foushee, 2010) and Threat and Error Management (Maurino, 2005) that aim to promote effective safety-related collaboration between pilots. By emphasizing the dynamic interplay between advanced avionics equipment and individuals’ mental states, the introduction of CRM training has been associated with an increase in flight crew speaking up prior to aviation accidents (Noort et al., 2021; Noort, Reader, & Gillespie, 2019). However, despite their widespread adoption, it remains unclear to what extent flight crew training programs effectively address sociotechnical factors. This is important because without addressing these, flight crew collaboration may remain ineffective as training gaps remain, safety management may deteriorate, and ultimately avoidable accidents may continue to occur.

3.3.2 Distributed Cognition

Traditional cognitive science may seek to understand an individual's reasoning, ability to learn, and decision-making process, whereas distributed cognition investigates these facets across social processes, and resources (e.g., environment, artifacts, technologies) over time (Hutchins, 2000). It aims to solve how social and material processes contribute to an individual's cognition. Along with understanding the various ways in which information is shared, distributed cognition also aims to analyze the medium with which information is shared (e.g., written, in-person, online, etc.) and the type of communication (e.g., nonverbal, verbal) (Hutchins, 2000).

Distributed cognition identifies three distinct cognitive processes: 1) across members of a social group, 2) between the coordination of material or environment structures (e.g., artifacts), 3) and how this information is shared across time (e.g., lessons learned from the past) (Hutchins, 2000).

An example can highlight how distributed cognition manifests in the flight deck: The Captain (CA) is the pilot flying (PF) while the First Officer (FO) is the pilot monitoring (PM). The PM is managing checklists and talking to Air Traffic Control. Together they are a social group (distributed cognition process 1). The CA has information regarding the feel of the airplane while the FO has information on the status of the systems. This information is shared between pilots and technology (e.g., the flight management system (FMS), the engine indicating and crew alerting system (EICAS), along with various computer monitoring systems specific to aircraft design). The FMS possesses the CA's knowledge of aircraft flight status (e.g., speed, altitude, barometric pressure, angle of attack) while also receiving input from the FO on system status (e.g., weight and balance information, fuel quantity). The FMS is an artifact (distributed cognition process 2) that receives from both the CA, FO, and aircraft systems. It then distributes the information across various processes resulting in a higher level of cognition than any part of the system analyzed in singularity. Furthermore, procedural checklists, a tangible cognitive scaffold, facilitate the distribution of cognition by enforcing an ordered sequence of operations that are temporally aligned with the aircraft's flight phase. These checklists are not static; they are the embodiment of cumulative aeronautical wisdom, iteratively refined through the incorporation of empirical advancements and historical insights, representing yet another layer of distributed cognitive processing (process 3) within the flight deck's sociotechnical nexus (Hutchins, 2000).

3.3.3 The Distributed Cognition of Pilots in a Sociotechnical System

Distributed cognition is a fundamental aspect of sociotechnical systems and can be a way for information to be disseminated. Essentially, a sociotechnical system can be seen as a network where distributed cognition occurs. As such, it can be a framework for analyzing aviation safety models and in that way help in understanding how systems can improve the cognitive processes of the crew, which in turn plays a crucial role in the successful operation of an aircraft and the overall safety of the mission.

Information on how pilots must operate as part of a sociotechnical system is provided through Crew Resource Management (CRM) training and through a

company's standard operating procedures (SOPs). CRM is a training tool in the socio-process designed to enhance the efficacy of the Threat and Error Management (TEM) model, which is aimed at successfully operating the technology (i.e., the aircraft). Pilots are trained on CRM/TEM through classroom training (ground school) and flight simulator training, and the principles are reinforced during flight operations. Checklists, training material, and SOPs constitute some of the artifacts or tools used to distribute cognition amongst social groups (e.g., pilots, training managers, flight attendants, and dispatchers, where applicable). These training materials and policies are updated periodically based on new technology or lessons learned, which is one dimension of information sharing over time. Checklists and procedures are conducted on a specific timeline (e.g., before takeoff briefing, cruise systems check, etc.), which is another dimension of information sharing over time. Seen in this light, it is clear that flight decks involve complex multidimensional time-based interactions within the framework of distributed cognition.

CRM/TEM is a tool of distributed cognition in the flight deck that highlights the importance of a healthy, functioning social or "socio" aspect of the sociotechnical system. When the socio aspect is not healthy (e.g., a flight deck microculture lacking psychological safety), the efficacy of the CRM/TEM model can deteriorate resulting in muted safety voice or safety silence, either one of which can negatively impact the functionality (or performance) of the technology (e.g., pilot error leading to an undesired aircraft state).

3.3.3.1 Theoretical Quantification of Muted Safety Voice and Safety Silence

Cockpit Voice Recorders (CVRs) of normal, day-to-day (i.e., not involved in an incident or accident) operations are hidden from public records. Gathering data from inside the flight deck to observe dynamic distributed cognition is limited to company Line Operations Safety Audits (LOSA), which are restricted from the general public due to union contracts and company litigation. However, inferences about distributed cognition across the socio aspect of the sociotechnical system can be deduced by combining four district data points.

Data Point 1: In 2006, the Federal Aviation Administration (FAA) published a white paper estimating that 60-80% of airplane accidents are due to human error (Federal Aviation Administration, 2006, p. 8).

Data Point 2: On an average day in the United States, air traffic controllers handle approximately 87,000 flights (National Oceanic and Atmospheric Administration, n.d.). Removing those of general aviation (27,128) and military (5,260) as we cannot assess whether they were operated as single-pilot operations or in a crew environment, we can infer that roughly 54,612 flights per day are operated as a crew environment in the United States.

Data Point 3a: According to early LOSA data, an average of 1.84 errors (Helmreich et al., 2001, p. 12) occur on every flight. Using the data from item 2, we can surmise that 100,486 (rounded to the nearest whole number) errors occur daily in US airline flight decks (54,612 flights per day x 1.84 errors per flight = 100,486.08 errors per day) or 36,677,419.20 annually.

Data Point 3b: Helmreich et al (2001) determined that 54% of the errors were intentional noncompliance (p. 11). Therefore, 54,262.48 errors occur annually because pilots intentionally do not comply with the policy.

Data Point 4: Table 3.3.3.1 (Perkins et al., 2022) highlights the frequency with which FOs transition from safety voice to muted safety voice or safety silence.

Table 3.3.3.1
Annual Instances of Muted Safety Voice and Safety Silence

Construct	Muted Safety Voice		Safety Silence	
N value	N=804		N= 808	
	N value	Percentage	N value	Percentage
0 instances: Never happened	195	24.2%	344	42.7%
1 – 10 / year	539	67%	420	52.2%
11 – 30 / year	51	6.3%	29	3.6%
31 – 50 / year	13	1.6%	5	0.6%
More than 50 instances a year	6	0.7%	10	1.2%

The US Bureau of Labor Statistics (2021) estimates there are 135,300 pilots operating as airline and commercial pilots in the United States. Using the percentages from Table 3.3.3.1, we can make an inferential quantitative analysis of the frequency at which muted safety voice (MSV) and safety silence (SS) occur annually. While these numbers are not absolute, they offer us a theoretical explanation for the frequency with which errors occur (reference DP3a and 3b).

Annual occurrence of Muted Safety Voice (MSV):
5 (average of 1-10 MSV/yr.) x 67% x 135,300 pilots = 453,255 MSV
20.5 (average of 11-30 MSV/yr.) x 6.3% x 135,300 pilots = 174,739.95 MSV
40.5 (average of 31- 50 MSV/yr.) x 1.6% x 135,300 pilots = 87,674.4 MSV
51 MSV/yr. x 0.7% x 135,300 pilots = 48,302.1
Total 763,971.45 instances of muted safety voice annually in US airline flight decks

Annual occurrence of Safety Silence (SS):
5 (average of 1-10 SS/yr.) x 52.2% x 135,300 pilots = 353,133 SS
20.5 (average of 11-30 SS/yr.) x 3.6% x 135,300 pilots = 99,851.4 SS
40.5 (average of 31- 50 SS/yr.) x 0.6% x 135,300 pilots = 32,877.9 SS
51 SSO/yr. x 1.2% x 135,300 pilots = 82,803.6 SS
Total 568,665.9 instances of safety silence annually in US airline flight decks

Total: There are 1,332,637.35 instances annually of professional pilots hesitating to speak up or self-silencing regarding safety-pertinent information in the flight deck.

3.3.3.2 Sociotechnical Systems with Disrupted Distributed Cognition

Data Point (DP)1 underscores that pilot error is still a safety concern in professional aviation. DP2 and DP3a estimate that there are 36,677,419.20 annual pilot errors in US airline flight decks.

The TEM model's creator, Helmreich, R.L., and fellow researcher Musson, D. M. advocate asking, "What were the conditions present that helped this error to occur?" (2000, p. 12). Speaking up with safety information is part and parcel to the process of identifying, mitigating, and trapping pilot errors as designed by the TEM model. Research shows that pilots are reluctant to speak up when the flight deck is not psychologically safe.

Therefore, we can theorize that an estimated 1,332,637.35 instances (DP4) of a reduction in TEM efficacy due to low psychological safety occur annually across US professional aviation. The inferential analysis allows us to estimate that perhaps 3.63% (1,332,637.35 / 36,677,419.2) x 100 = 3.6334%) of all annual errors could be mitigated simply by training pilots on methods to create psychological safety.

When information is withheld due to poor CRM, not only does the TEM model break down, but the distributed cognition within the sociotechnical system is disrupted. Clearly, a process improvement for both CRM and TEM is necessary and should include adequately training pilots on the development and maintenance of flight deck psychological safety.

There is limited data on the average level of psychological safety in airline flight decks. However, utilizing previous research on marginalized groups in aviation can provide insight into how culture and leadership inclusivity impact psychological safety (Edmondson, 2019), a concept explored more fully in the following chapter.

Not every pilot error, muted safety voice, or safety silence brings about an undesired aircraft state because the system has defenses. One of the more critical defenses in a sociotechnical system is that of resiliency.

3.4 Resilience

Resilience, as a construct, manifests with considerable versatility across a multitude of disciplinary contexts, each field tailoring its conceptualization to suit its distinct application and interpretive requirements. The ecological domain viewed resilience as the "persistence of system relationships and the ability of a system to absorb external changes" (Taysom & Crilly, 2017, p. 166). Resilience in a sociotechnical system has been defined as the "ability to withstand or bounce back from some shock" (Ruth & Goessling-Reisemann, 2019, p. 2). Within this definition, characteristics of

resilience include resisting or recovering from influences or changing to accommodate influences (p. 3).

Because the flight deck is a sociotechnical system, the concept of resilience must be viewed through an engineering lens and focus on complex adaptive systems. Woods (2015) looked at various definitions of 'resilience' across a multitude of disciplines and identified four core concepts to explore individually. His four basic concepts of resilience are as follows:

> "(1) resilience as rebound from trauma and return to equilibrium; (2) resilience as a synonym for robustness; (3) resilience as the opposite of brittleness, i.e., as graceful extensibility when surprise challenges boundaries; (4) resilience as network architectures that can sustain the ability to adapt to future surprises as conditions evolve" (p. 5).

In this chapter, I focus on Resilience 1 (R1) and 3 (R3). I argue that the nuances of these concepts provide clarity and illuminate how interpersonal skills training increases the resiliency of the socio-processes in the flight deck.

Resilience 1 parallels the previous definitions explored. These require an outside force to influence the system negatively. In the TEM model, this type of resilience would be measured in how the sociotechnical system responded to a threat. For example, pilots receive a vector from Air Traffic Control that conflicts with another aircraft's trajectory (threat of midair collision). The Traffic Collision Avoidance System (TCAS) warns pilots of the increased risk of a midair collision. They perform the appropriate maneuver to deconflict the incoming aircraft and then return to their appropriate altitude and speed once clear of the traffic. The system has rebounded from disruption and returned to equilibrium.

Resilience 3 will be a focal point of subsequent chapters. Woods (2015) recommends reframing the definition of resilience to include bouncing back (as seen in Resilience 1 and Resilience 2) but as a system that stretches to handle surprise (p. 7). Systems with graceful extensibility have predictive features in that they have the capacity to anticipate bottlenecks and have the readiness (or capacity) to adjust to challenging conditions. We can think of Resilience 3 as we consider CRM training. In an ideal scenario, Captains are trained on how to adapt their leadership style to extract the best possible performance from their First Officer(s). Good CRM training offers Captains a toolbox of interpersonal skills training to handle conflict, motivate individuals, and use interpersonal communication as a tool to generate psychological safety. Good CRM training is, therefore, part and parcel of designing for Resilience 3 in the sociotechnical system of the flight deck.

Woods warns that when a system must stretch repeatedly to have graceful extensibility to multiple challenges, a negative consequence is the fatiguing or over-stressing of the system. We can see this play out with interpersonal skills as well. When a Captain must work very hard to motivate a First Officer or when a First Officer works extremely hard to adapt to the tone established by the Captain, fatigue is increased. When the interpersonal relationships of the pilots are strenuous, stress increases.

Sociotechnical systems often have multiple stakeholders (Taysom & Crilly, 2017) who may have different subgoals, perspectives, and motivations. For example, the gate agent may be motivated by the on-time performance of the aircraft leaving the gate

while a mechanic is focused on the aircraft leaving the gate with no maintenance write-ups. If we want to design a better system, it will require gathering varied feedback from numerous stakeholders. It has been argued (Ruth & Goessling-Reisemann, 2019) that individuals and institutions within a sociotechnical system possess limited capacity to understand and discern their role in the system. This capacity expands or contracts through past experiences, especially from past failures (p. 2), and can be enhanced through education and training. I argue that interpersonal skills training can increase the resiliency of the flight deck sociotechnical system and increase the adaptive capabilities of pilots to respond collaboratively - and that the consequence would be enhanced safety.

To best understand the failures of the socio-process or the brittleness (lack of resiliency) of the system, we must explore the individuals that comprise the system. As each individual within the flight deck brings varying levels of competency for interpersonal skills, I focus on individualistic traits that compound the potentiality for the brittleness of the system by exploring the psychology of deviance from CRM/TEM protocols.

3.5 The Psychology of Crew Resource Management Deviance

We have discussed the reliance of psychological safety on the activation of safety voice. Without psychological safety, people withhold information for various reasons including saving face and fear of negative repercussions. I have shown that people with power may not see the link between showing sensitivity toward others and good CRM/TEM. One area I have yet to explore is the deviance from CRM practices on an individual level.

The Operator's Guide to Human Factors in Aviation (OGHFA), written by the Flight Safety Foundation's European Advisory Committee, highlights various explanations for why the principles of CRM may erode in the flight deck due to individual processes (SKYbrary, n.d.). The paper explains that pilots may not embody good CRM due to poor training, fatigue, misunderstandings due to cultural differences (not a focal point as this research focuses on US pilots only), and the influence of dysfunctional organizational cultures. It continues to explain how individual personalities, attitudes, and emotions influence the efficacy of CRM and offers methods for preventing erosions of CRM principles. For simplicity in the discussion, I extract pertinent concepts and catalog them below for discussion:

Causes of poor CRM (OGHFA, SKYbrary, n.d.)

- Emotional status. A very negative experience, personal or occupational, can degrade resource management skills.
- Individual personality and attitude. Some people, by nature, do not want to listen to others and shun anyone who speaks up with an opinion contrary to theirs.
- A "them and us" attitude toward other aviation workers. Teamwork is built on mutual respect. Pilots certainly have a safety-critical job, but they cannot perform it effectively without help from the other team members.

- Prejudices against people. If someone has a negative attitude toward another person because of factors such as their background, culture or gender, it is less likely that interactions with that person will be positive.
- Poor attitude. If someone has an inflated view of themselves, their resource management will likely suffer. For example, believing one is almost invincible or infallible makes it difficult to work as a member of a team.

The Operator's Guide offers anecdotes of these hazardous conditions and recommends that pilots become aware of their own attitudes, be open to the differences of others, and it advocates tolerance while beseeching pilots to "not be prejudiced against others" (SKYbrary, n.d., section 5). These concepts sound well-intentioned but rely on the emotional intelligence of the individual and their willingness or ability to voluntarily adopt a growth mindset and become self-aware.

Previous research found that pilots, in general, score lower on the trait of emotional intelligence than the general public. Controlling for age, gender, ethnicity, and educational experience, pilots scored lower on well-being, self-control, emotionality, and sociability than the non-pilot group (Dugger, Petrides, Carnegie, & McCrory, 2022).

Given that those in power may be less likely to link interpersonal skills with safety (see section 3.2.5 of this chapter) yet are required to set the flight deck tone (FAA, 2004) and that pilots, in general, score lower on emotional intelligence (Dugger, Petrides, Carnegie, & McCrory, 2022), it would be irresponsible to rely on individual processes to enhance the efficacy of CRM/TEM.

The pertinence of psychological safety in aviation cannot be overstated; it is the bedrock upon which the safety voice is activated, enabling the free flow of crucial safety-related information. When psychological safety is compromised, individuals may withhold information due to fears of reprisal or loss of face, detrimentally impacting team dynamics and the effective application of Crew Resource Management (CRM) and Threat and Error Management (TEM) principles. This is further exacerbated by findings that indicate pilots may have lower emotional intelligence compared to the general population, suggesting a heightened need for structured interventions in CRM/TEM training rather than reliance on individual volition.

3.6 Individual-level Barriers vs. System-level Solutions

The preceding section outlines various individual-based barriers to effective CRM/TEM, such as emotional intelligence, personality traits, attitudes toward teamwork, prejudices, and self-perception. Overcoming these specific barriers relies primarily on individual behavior change - a strategy this dissertation argues against.

Given pilots' lower scores on emotional intelligence traits, it would be imprudent to anticipate individual pilots' autonomous realization of the importance of enhancing CRM/TEM training. Moreover, as demonstrated in section 3.2.5, there is a discernible correlation between those with relative power (Captains and men) having a deficiency in comprehending the relevance of specific interpersonal skills (namely, demonstrating sensitivity toward other crewmembers) in enhancing safety. Therefore, it would be irresponsible to assume pilots can overcome these individual barriers without a systemic intervention.

In light of these considerations, it becomes apparent that relying solely on individual behavior change to overcome barriers to effective CRM and TEM is insufficient. Instead, there is a pressing need for systemic changes within the aviation industry, including improvements in pilot training and selection processes, the establishment of supportive organizational cultures that prioritize psychological safety, and the implementation of structured interventions within CRM/TEM training programs. Only through a system-level frame (s-frame) approach can the underlying issues contributing to individual-based barriers be adequately addressed, thereby enhancing aviation safety outcomes.

3.6.1 S-frame Solutions

Initiatives focusing on intervening on an individual's thoughts, feelings, and behavior are considered an individual-frame or i-frame intervention (Chater & Loewenstein, 2022) such is the work of behavioral and cognitive scientists. We can contrast this type of intervention with that of a systems-frame or s-frame, which focuses on public policy and institutional societal norms. Sociologists, social psychologists, and politicians may use s-frame intervention in order to change the rules of the game or shift the paradigm (Chater, & Loewenstein, 2022), to impact an individual's thoughts, feelings, and behavior.

I-frame interventions may be counterproductive because 1) when a person adopts a particular frame, "other frames are difficult to access" (Chater, & Loewenstein, 2022, p. 7), and 2) i-frame solutions may inadvertently mask systemic problems by relying on individuals to overcome their personal weaknesses rather than dismantling a system that is itself the problem because of the assumptions it makes on how changes in human behavior can be achieved.

Therefore, I advocate for the regulatory authorities and ICAO to focus on an s-frame solution to fill the training gap and increase the efficacy of CRM/TEM by removing the erroneous assumptions on which the models were built. We cannot wait for a collective epiphany of pilots to individually seek enlightenment on collaborative safety.

The aviation industry's imperative to focus on systems-frame (s-frame) solutions stems from the recognition that systemic issues often manifest through individual behaviors and cannot be effectively resolved through individual-focused interventions alone. S-frame solutions address the underlying structural and institutional factors that govern individual actions, which are often products of the broader system in which they operate. By reforming public policy, altering institutional norms, and reshaping the 'rules of the game', s-frame interventions aim to create an environment that naturally elicits desirable behaviors, rather than relying on individuals to change within a potentially flawed system. This approach is particularly relevant in high-stakes environments like aviation, where the complexity and interdependence of factors affecting safety are profound and where the consequences of failure are severe. Focusing on s-frame solutions ensures that the systemic drivers of risk are addressed, promoting a more sustainable and comprehensive enhancement of safety practices.

3.7 Chapter Conclusion

This chapter delves into the intersection of social and organizational psychology with aviation safety, emphasizing the importance of interpersonal skills training in fostering safety voice activation within the flight deck. It advocates for viewing the flight deck as a sociotechnical system and argues for a systemic training approach.

Central to the chapter is the argument for adopting a systemic approach (s-frame) to training in aviation. This approach is necessitated by two critical observations. Firstly, the chapter underscores a notable trend where individuals in positions of relative power within the flight deck are less likely to perceive the intricate connection between interpersonal skills and safety outcomes, particularly within the scope of Crew Resource Management's focus on sensitivity. This insight necessitates a targeted approach in training that bridges this cognitive gap. Secondly, the chapter draws on recent research (Dugger, Petrides, Carnegie, & McCrory, 2022) to highlight a general tendency among pilots to score lower on measures of emotional intelligence. This finding is significant as it implies a potential lack of self-awareness among pilots regarding how their own attitudes, beliefs, and emotions can profoundly influence their behaviors. Such a lack of self-awareness can have cascading effects on the level of psychological safety within the microculture of the flight deck, ultimately impacting safety outcomes.

In conclusion, the chapter lays the groundwork for reimagining flight deck training and prioritizing interpersonal skills within a broader sociotechnical framework. It advocates for training methods that not only enhance technical proficiency but also deepen understanding of the psychological and social dynamics of the flight deck environment. This approach aims to foster effective communication, enhance safety, and create a more inclusive and psychologically safe workplace for all flight deck personnel. Having established the importance of advanced interpersonal skills for safety outcomes, the following chapter examines their potential utility in achieving diversity goals for women in aviation.

Chapter 4 - Related Literature: Women in Aviation

4.1 Chapter Overview

The previous chapter analyzed culture as an influencer *of* people while also influenced *by* people. We expand on this understanding by analyzing the industry culture through the lived experiences of those who do not comprise the majority of professional pilots: women. Drawing on social psychological concepts, it examines how minority status is perceived within the aviation culture, aiming to deepen insights into interpersonal skills, safety culture, and psychological safety.

In this chapter, we delve into the concept of prototypes within the aviation domain, exploring the idealized image of a pilot through a historical and cultural lens. We begin by defining a prototype as an abstract construct embodying the quintessential characteristics of a category (Kaiser et al. 2022). Building upon our understanding of the gendered heritage of aviation and the historical exclusionary practices towards non-White and non-male aviators, we examine how the prototype of a pilot has been shaped over time.

Through this examination, we aim to elucidate the complex dynamics underpinning the perpetuation of masculine defaults within the aviation industry, informed by factors such as societal perceptions of power and early academic research delineating gendered behaviors in the flight deck. Insights from women aviators are shared, emphasizing the importance of psychological safety, and advocating for a cultural shift in aviation. This shift aims to address industry diversification objectives, resolve the gender balance disparity to alleviate the projected pilot shortage, and enhance existing safety frameworks simultaneously.

4.2 State of the Industry: Where are the Women?

Of the 163,934 United States certified pilots holding the Airline Transport Pilot license (ATP), the license required to fly for an air carrier, a mere 7,698 (or 4.7%) are women (Pilot Institute, 2021). It is unlikely that these percentages will increase rapidly as the current rate of recruitment of women in aviation remains relatively constant at 1% per decade (Federal Aviation Administration, 2022). Without a revolutionary intervention, we can infer that it will take another 430 years before the United States sees a semblance of gender parity in the flight deck. The low representation and disappointing recruitment rates result in a significant gender imbalance which constrains our resource pool for addressing the shortage of pilots. The vexing question “why are there so few women in aviation” has been asked and has remained vexing for nearly a century. It is worth noting that there is a pressing need for a greater number of qualified pilots to address the current and anticipated pilot shortage. Addressing the issue of negative culture (as we’ll discuss throughout this chapter) may serve as a step towards resolving the pilot shortage.

The early legal and exclusionary policies banning women from the flight deck were officially removed in the 1970s (Haddad, 2019); yet their historical and systemic

influence remains. Ultimately, notwithstanding the elapse of five decades since the legal authorization for women to pilot air carrier aircraft, the continued prevalence of a gender disparity within the industry has merited the scrutiny of legislative bodies.

In 2021, a Congressionally mandated task force of industry experts and leaders was formed to provide the Federal Aviation Administration (FAA) with recommendations on ways to encourage female students and aviators to pursue a professional aviation career (Federal Aviation Administration, 2022).

The report culminated by presenting a compendium of fifty-five recommendations. Yet, it is the prefatory commentary of the report that holds especial significance for the research objectives of this dissertation. In the Statement from the Chair, the report highlights culture as being the predominant barrier for women in aviation:

> "The biggest barrier that discourages women from entering and staying in aviation careers is culture – and it is the hardest to change. Women don't feel like they belong." (Federal Aviation Administration, 2022, p. 3)

To best understand the genesis of this negative culture, we must explore the gendered heritage of the aviation industry.

4.3 A Gendered Heritage

The ensuing subsection incorporates work from Perkins, K., Merola, R., Ghosh, S., Aragon, C. (2024). "'I'm a Pilot First, Female Second': Why Flight Deck Gender Imbalance Persists and the Case for Allyship." *Journal of Aviation/Aerospace Education and Research.*

The year 1939 was momentous for women interested in aviation because, with the threat of war looming large, President Franklin Roosevelt's Civilian Pilot Training Program (CPTP) was signed into law, and the US opened the skies to any American between the ages of 18-25 and provided the opportunity to learn to fly at government expense (Meyer, 2015). This program allowed women and non-White Americans unexpected access to aviation training and piloting opportunities, with noticeable funding being allocated to women's and historically black colleges and universities. By 1941, 2500 women had earned their wings (Meyer 2015). However, this influx of women pilots came to an abrupt halt only two years after the program's inception. As it became increasingly clear that America would enter the War, the US Congress changed the rules of the CPTP to require all participants to join the military. Women were no longer welcome, and while White women could still find positions as a WASP, no Black women were given WASP membership (Merry, 2014).

By 1944, the CPTP had minted 435,000 new aviators, nearly 99% of whom were young, White men (Meyer, 2015). The same year, Robert Ramspeck waved away General Henry Arnold and WASP chief Jacqueline Cochran's attempts to expand the program under the auspices of the military and instead consigned the WASPs to history on the floor of the US Congress. Instead, Congress passed the Servicemen's Readjustment Act, better known as the GI Bill of Rights, in order to help 16 million returning veterans integrate back into civilian life. Having been exposed to aviation during their time in the service, 350,000 such veterans had enrolled in flight schools by

1947, ably supported by GI funding. Due to the limitations set on women and non-White men, those with access to the GI money mostly reflected the same demographic of aviators who had access to the CPTP: White men. The CPTP and GI Bill of Rights ignited the US aviation industry, but mainly just for White men, creating governmentally established demographic disparities that persist even today.

Instead, women returning from war and wanting to be involved in aviation only found themselves able to become flight attendants due to prohibitive policies. This created a stereotype that women in aviation belonged in the cabin, not in the flight deck. This stereotype was very much perpetuated by physical appearance requirements bestowed on flight attendants, such as a requirement to have conventional standards of beauty in terms of height and weight (Schlappig, 2021). The effects of these wartime and post-war policies are still prevalent today, with women constituting 79.2% of all flight attendants in the US (Pilot Institute, 2021), far higher than the national average of the service industry, which is 57.7% women (United States Department of Labor, 2021).

In the 1950s, an aircraft manufacturer used women as a marketing tool boasting that their airplane was so easy to operate that even a woman could fly it (Meyer, 2015). The negative sentiments were aimed not only at women but at any aviator who wasn't White and male. In 1969, aviation enthusiasts were exposed to a controversial article in the well-established and prominent magazine, *Flying*, titled "Can a Black Man Fly?" (Meyer, 2015). This article spurred hate mail from the dominant group (Meyer, 2015), indicating that the suggestion of diversity elicited a threat-response. This is a concept we explore further in subsequent sections.

In the decades that followed the CPTP and the GI Bill of Rights, women faced both covert and overt forms of discrimination as the doors to the flight deck continued to be defended with the fervent belief that piloting was a man's industry. The Air Line Pilots Association (ALPA) vehemently upheld a ban on women from operating air carrier aircraft (Meyer, 2015). If women did find their way into training programs or flight schools, they were liable to be fired for getting married or reaching certain ages (Grant K., 2018). When the Civil Rights Act of 1964 created the Equal Employment Opportunity Commission, one of its first effects was to prevent airlines from firing women employees who got married, after several lawsuits from women flight attendants (National Air and Space Museum, 2021).

In the 70s, under growing pressure both from women activists and aviation enthusiasts as well as from rising international acceptance of women pilots, the US commercial aviation industry finally opened the flight deck door to women. Around the same time, a similar decision was made within branches of the US military, making this decade a prominent one where many women were hired as pilots. To many, this is where the story should end – having arrived at a situation where women are allowed equal access to piloting opportunities as men. Unfortunately, such was not the case. Women who earned a seat up front found the flight deck to be a discriminatory workplace fraught with a culture of gender bias (Meyer, 2015).

The negative culture described by the 2020 FAA report mirrors the sentiments of the negative culture experienced by women and non-White men from the industry's infancy. The aviation industry's history of gender bias has fostered perceptions that

resulted in the creation of two groups: an in-group (White men) and an out-group (women and non-White men).

4.4 Consequences of the Gendering of an Industry

As demonstrated in the previous subsection, the male-dominated aviation industry did not take kindly to the entry of women into the flight deck. Studies found a culture of micro and macro aggressions towards female pilots (Ashcraft & Mumby, 2004; Kristovics, Mitchell, & Vermeulen, 2006), which resulted in women pilots being viewed as 'out-group' members (Molenberghs, 2013). This created a culture of unfavorable treatment for women pilots (Ragbir et al., 2021), a culture that is still prevalent (Yanıkoğlu, Kılıç, & Küçükönal, 2020).

Research shows that female pilots are more likely to be perceived negatively solely because of their gender (Walton & Politano, 2014). Gender bias manifests itself in various forms. "A woman in the cockpit is one less in the kitchen" or "If women were meant to fly, the sky would be pink" are examples of explicit sexism that women pilots have reported hearing in their jobs (Mitchell, Kristovics, & Vermeulen, 2005; Vermeulen & Mitchell, 2007). Not all forms are so obviously overt. Women aviators may experience forms of *benevolent sexism*, in which attitudes that seem positive in tone may suggest inferiority to men based on supposed fragility, need for protection, or lack of competence (Glick & Fiske, 1997). For example, the positive stereotyping in comments such as "women make better pilots because they're softer on the controls" is a form of benevolent sexism as it reinforces the belief men have that women are inferior because they are fragile — a belief that perpetuates stereotypes, and contributes to *othering* women (that is, the marginalization of women). Benevolent sexism may be harder to spot than explicit sexism, but both forms contribute to the negative culture created by gender bias. The FAA Women in Aviation Advisory Board's report highlighted this negative culture, as the following demonstrates:

> Women are 'allowed', but are not always supported throughout the system, and instead challenged to find a way to 'fit in' and be successful. However unconscious or unintentional, false perceptions of equality, a credibility gap, gender stereotypes, bias, harassment, and tokenism can impact women at every stage of their careers—and stand as a direct obstacle to aviation's best future. (Federal Aviation Administration, 2022, p. 46)

Some academics have addressed gender bias head-on. In "How Pink is the Sky?", researchers ranked sexism across national borders, with Australia being only slightly more hostile toward women pilots than America (Mitchell, Kristovics, Vermeulen, Wilson, & Martinussen, 2005). Explicitly calling out sexism is a necessary method to raise awareness, yet it does not offer tangible solutions as an intervention to curb exclusionary behavior.

Airplane crashes have been analyzed across gender lines (McFadden, Comparing Pilot-Error Accident Rates of Male and Female Airline Pilots, 1996) to determine which gender makes the most fatal errors (Baker, Lamb, Grabowski, Rebok, & Li, 2001). Gender has been used as a variable in general aviation accidents (see Bazargan & Vitaly, 2011) and academic instruments have been developed to measure

gender-related pilot behavior (see Vermeulen & Mitchell, 2007). Men are often viewed as the standard or norm, while women are viewed as *other* or analyzed in terms of how they differ from the default (men). I argue that gendering safety does little to rid the industry of inherent gender bias, nor does it contribute to the production of an inclusive culture.

4.4.1 The Gendering of Safety

The gendering of safety, as we define it (Perkins et al., 2024), are the practices and phenomena of attributing safety-related behaviors, skills, and outcomes to gender differences, and how these perceptions influence the treatment, training, and evaluation of pilots. It encompasses the historical and ongoing stereotypes and biases that suggest men and women possess inherently different capabilities when it comes to aviation safety, often to the detriment of female pilots. These stereotypes have led to a culture where female pilots feel compelled to adopt traditionally masculine behaviors to be accepted and respected in the flight deck. The concept also covers the research and discourse around pilot error rates, accident rates, and performance differences, highlighting that when controlling for relevant variables, there is no significant difference in the safety records of male and female pilots (Archer, 2015). "Gendering safety" underscores the problematic nature of basing safety assessments on gendered stereotypes rather than individual competencies and suggests a need for a shift towards more inclusive and unbiased evaluation and training practices in aviation.

The remaining paragraphs of this subsection incorporate work from Perkins, K., Merola, R., Ghosh, S., Aragon, C. (2024). "'I'm a Pilot First, Female Second': Why Flight Deck Gender Imbalance Persists and the Case for Allyship." *Journal of Aviation/Aerospace Education and Research.*

In the aviation industry, safety is paramount, and significant attention is paid to research and development to enhance flight safety. Some studies have explored the role of gender as a predictor variable in the frequency and severity of the pilot error and in creating a 'safety gap' in the flight deck (Novello & Youssef, 1974; McFadden, 1996; Baker, Lamb, Grabowski, Rebok, & Li, 2001; Archer, 2015).

Early research on pilot characteristics (although conducted on a small and homogenous sample size) concluded that male general aviation pilots exhibit more dominance and heterosexuality, demonstrating far less ability to display deference or nurturing abilities when compared to the 'average' US male (Novello & Youssef, 1969). The study painted male pilots as adventure-seeking, egotistical exhibitionists. However, even such exhibitionistic men were considered safer than women pilots, since the study's authors believed men would have the composure and ability to make clear-headed decisions in safety-critical situations, whereas women would give in to their emotions. The same researchers conducted a further study in 1974 on the profile of the female pilot. It claimed that the personality profile of women pilots has "the greatest resemblance to the male pilot profile, second highest resemblance to U.S. adult males, and least resemblance to the U.S. adult female" (Novello & Youssef, 1974, p. 632). This research paved the way for the characterization of women pilots as butch, *she-man* aviators. Despite the methodological limitations (e.g., a small and homogenized sample

size), Novello & Youssef's research is still referenced decades later (McFadden & Towell, 1999) and even lauded as "seminal" (Archer, 2015, p. 14).

Their findings laid a misogynistic framework for harmful typecasting, one that is still prevalent in modern flight decks. As recently as this decade, women have reported the need to demonstrate stereotypically masculine traits in the flight deck for the microculture to feel inclusive. For example, in an interview quoted in Yanıkoğlu, Kılıç, & Küçükönal's research one professional female pilot reported: "In general, we start to become more masculine. Our conversations are becoming a bit like a man. Maybe in your normal life you are dressed very feminine, do make-up, and be well-groomed but when you enter the cockpit, you start to act in a more masculine way to get yourself accepted or not to take negative attention" (2020, p. 5).

This gendering of safety was studied in greater detail near the turn of the millennium. McFadden (1996) studied the pilot-error accident rates for women and men U.S. pilots flying for major airlines. After adjusting for variables such as tenure in the flight deck and total flight time, they found that accident rates for women and men pilots did not differ significantly (McFadden, 1996). Subsequent research found that women were slower to gain confidence in their ability to handle the airplane and required more hours to fly solo yet were quicker to grasp instrument flying and were smoother on aircraft controls (Turney, 2004). This finding was in opposition to research conducted a few years prior, which concluded women pilots were more likely to have accidents from errors of mishandling the aircraft (Baker, Lamb, Grabowski, Rebok, & Li, 2001). A subsequent study by Bazargan and Guzhva (2011) determined that the likelihood of a general aviation accident caused by pilot error was not related to pilot gender. However, their research showed that accidents caused by men pilots were more likely to be fatal.

A meta-analysis of these studies (Archer, 2015) shows that women and men pilots have similar levels of pilot error, incidents, and accidents, indicating that the pilot training curriculum ought to be a focal point in reducing pilot error, not a gender analysis. When research compares gender, it often emphasizes how women differ from men. This implies men are the standard; they are the default, which relegates women to being viewed as having *other* status or deviating from the norm (Reeder, 1996). Inherent in this default is the fabrication of a *them vs us* mindset, which is divisive and does little to foster a collaborative environment but does much to undermine safety.

This excerpt highlights the criticality of addressing gender biases in the aviation industry, emphasizing that the perpetuation of stereotypes can have detrimental effects on safety and inclusion. The early research by Novello & Youssef and subsequent studies play a pivotal role in shaping perceptions of gender roles within the flight deck, which can influence the training, performance, and acceptance of female pilots. The findings from these various studies underscore the necessity for an objective and inclusive approach to pilot training and evaluation, focusing on individual competencies rather than gender-based assumptions. This is particularly important given the evidence that when controlling for experience and training, gender does not significantly impact pilot error rates. Hence, it is paramount that the aviation sector moves beyond archaic stereotypes to foster a safety culture that values competence over gender, as this will enhance operational safety and promote a more inclusive work environment for all pilots.

4.4.2 The Act of Gendering and the Formation of Groups

Social identity theory explains that social categorization is a "system of orientation which creates and defines the individual's own place in society" (Tajfel, 1974, p. 69). Humans derive identity through the formation of groups. One's membership is dependent on other group members and how one identifies given current surroundings. Therefore, group membership is permeable. Individuals may transition between groups and across group identities based on the situational or the context. For example, one may find that their group is that of *pilots*. But, in a convention hall filled with pilots, one may then find another social categorization of *aerobatic pilot*. In this light, one's group is situational relative to the presence of others.

Categorization can also be socially assigned based on observable traits. Research on children's understanding of social categorization demonstrates that gender is a category recognized in early childhood (Lei & Rhodes, 2021) highlighting how deeply ingrained gender is as a group-identifiable variable.

According to intergroup emotion theory (Mackie, Smith, & Ray, 2008) intergroup behavior is driven by social emotions which are, themselves, generated by a sense of belonging to one group over another. It is a natural proclivity of humans to think of one's own group as superior to other groups (Tajfel, 1974). The negative sentiment toward out-group members helps to strengthen a sense of belonging to in-group members; therefore, bias toward out-group members may be less about direct hostility and more due to preferential treatment toward in-group members (Brewer, 1999). Regardless of what this phenomenon is motivated by, negative sentiment and/or biases appear to be inherent in group dynamics.

I turn toward social psychological concepts to deepen the analysis of the nuances that contribute to the defining of groups.

4.5. Defaults, Prototypes, and Stereotypes

Feminist communicology defines gender as a social construct (Ashcraft, 2012) in contrast to biological sex, a distinction overlooked by much of aviation academic research and by the FAA. Past aviation research has largely viewed biological sex in binary terms (e.g., female vs. male) and conflated it with gender (woman vs. man) and gender manifestations (femininity vs. masculinity). Given that the FAA currently only collects biological sex data of pilots in binary terms (Federal Aviation Administration, 2022), I will superimpose *males* with *men* and *females* with *women* when colloquialism and syntax clarity benefit from the interchange. However, I acknowledge that gender is a social construct that manifests beyond the duality of these terms.

4.5.1 Defaults

I argue that the gender roles and gender defaults—that is, assumptions based on gender, often without explicit justification, discussed below have little to do with biological sex; rather, they are constructed and maintained through power structures

benefiting the dominant group (men, specifically White men) and subjugating the subordinate group (women) to *other* status.

The early decades of the 21st century have seen an adjuration for equality. This plea has been seen in workplace environments in corporate commitments, mottos, and initiatives—all promoting diversity, equity, and inclusion. While some organizations may only provide rhetoric for these principles, others strategize ways to dismantle the status quo and rebuild with egalitarian policies and structures. Despite decades of this crusade, women remain statistically underrepresented in STEM (Cheryan, Master, & Meltzoff, Cultural stereotypes as gatekeepers: increasing girls' interest in computer science and engineering by diversifying stereotypes, 2015) and aviation (Federal Aviation Administration, 2022). A plausible hypothesis is that organizations, despite their ostensibly good intentions, may inadvertently perpetuate entrenched masculine norms, thereby conferring a disproportionate disadvantage upon female members within the institution.

Masculine defaults - assumptions, norms, or standards based on male perspectives - exist when organizations, institutions, and/or industries value and reward behaviors that are typically associated with the male gender (Cheryan & Markus, 2020). Masculine defaults, such as organizational styles that expect assertive interjection to be heard or a system where employees are expected to self-nominate for promotion or bonuses (Cheryan & Markus, 2020), are prominent throughout the aviation industry. When behaviors like these are deemed to be the norm or standard, masculine defaults are prevalent.

The aviation industry is often viewed as a meritocracy (Newton, 2019). This belief is a masculine default as it disproportionately benefits men by masking privilege and perpetuating the status quo (Lombard, Azpeitia, & Cheryan, 2021).

In the United States, gender roles for women tend to be other-oriented (e.g., collaborative, kind, considerate) while those for men tend towards self-orientation and independence (e.g., strong, type-A, self-made) (Cheryan & Markus, 2020). These roles and their respective traits have seeped into aviation culture as we saw in section 4.4.1 with the default creation or the female pilot as a *she-man* aviator lacking average feminine qualities (Novello & Youssef, 1974). The research conducted by Novello & Youssef, which is both exclusionary and methodologically deficient, advanced to the extent of characterizing male pilots as assertive exhibitionists. Their conclusions, drawn from a psychoanalytic perspective, posited that such a profile corresponds to an active-masculine or 'phallic' archetype (Novello & Youssef, 1969, p. 187). These particular traits and characteristics were posited as the paradigmatic qualities for pilots, thus instituting a masculine standard within the field of aviation.

The importance of scrutinizing gender roles and defaults in the aviation industry lies in the recognition that these constructs are not inherently tied to biological sex but are instead the byproduct of historical power dynamics that privilege a dominant group. These constructs, which predominantly benefit White males, systematically subordinate women by relegating them to an "other" status. The appeal for equality, despite being echoed in contemporary corporate discourse, has yet to be fully realized, as evidenced by the persistent underrepresentation of women in fields like STEM and aviation. The perpetuation of masculine defaults within these sectors suggests that meritocratic

beliefs may inadvertently uphold male-centric norms, thus obfuscating the privileges afforded to men and preserving the status quo. Such defaults not only uphold behaviors traditionally associated with masculinity but also perpetuate an organizational culture that aligns with male-oriented traits. This misalignment has tangible implications, fostering an environment where women must conform to the masculine archetype to succeed, thereby reinforcing the masculine default and impeding the progress toward a truly inclusive and egalitarian workplace.

4.5.2 Prototypes

A prototype is “an abstract, fuzzy set of shared features describing the idealized member of a category” (Kaiser, Bandt-Law, Cheek, & Schachtman, 2022, p. 225). The prototype of a pilot, as described above, is one that exudes power, and strength, and exhibits hypermasculinity. Essentially, the prototypical pilot is laden with masculine defaults.

With an understanding of the gendered heritage of aviation from previous subsections and the historically exclusionary policies toward non-White men, the pilot prototype was molded to be distinctly male and noticeably White. Within the confines of Whiteness and maleness, the prototype has evolved over the past century. The industry and flying public witnessed its metamorphosis from the ‘ace’ pilot of the aerobatic performer (pre-WWII) to grease monkey (WWII), and the post-war dashing playboy of the Pan Am era. This prototype of the ideal pilot was fortified when compared to its crew counterpart: flight attendants. The highly sexualized flight attendants of the 1960s and 1970s (Meyers, 2015), which were predominantly women, created the stereotypical ideal occupational coupling: the hyper-sexualized flight attendant with the hypermasculine pilot.

The genesis of gendering aviation began in the industry’s infancy but was epitomized by the romanticization of the airline in its heyday (e.g., the Pan Am era). The image of the ideal prototype male pilot began in the late 19th and early 20th centuries and extends to the present sustained by many factors, among them, particularly, the dominant group’s threat response at the perceived loss of power (Ashcraft, 2005) and early academic research solidifying masculine default behaviors in the flight deck.

4.5.3 Stereotypes

Feminine stereotypes, such as being nurturing, agreeable, modest, patient, and interdependent (Cheryan & Markus, 2020) exist in direct opposition to the male pilot prototype. Women pilots may find that they must attempt to meet the demands of feminine stereotypes but also embrace the male pilot prototype. This double bind (Lombard, Azpeitia & Cheryan, 2021) comes with many costs, one of them cognitive.

Given the divergent nature of social goals and their capacity to engender distinct behavioral responses (Bergsieker, Shelton, & Richeson, 2010), it is plausible to postulate that the reconciliation of these disparate social objectives necessitates a substantial allocation of cognitive resources. Such cognitive resources, in contrast,

remain at the disposal of the dominant group, who are not encumbered by the same requirement for behavioral adaptation. Furthermore, the imposition of feminine stereotypes upon female aviators, coupled with the perpetuation of a pilot archetype imbued with masculine norms, cultivates an environment characterized by exclusionary practices.

4.5.4 Navigating Out-Group Hostility

A pilot who conforms to the male pilot prototype may demonstrate hostility toward a pilot who does not. In order to reduce the hostility expressed towards the out-group, those in the subordinate group (women) may attempt to assimilate. One method of assimilation is to mirror the dominant group by "adopting dominant group codes in an attempt to make one's co-cultural identity more (or totally) invisible" (Orbe, 1998, p. 249). Mirroring has been observed in the flight deck as an aggressive assimilation strategy when Black women aviators faced gender and racial bias (Zirulnik & Orbe, 2019). Likewise, mirroring occurs when female aviators feel they must hide their femininity (Yanıkoğlu, Kılıç, & Küçükönal, 2020) for fear of being viewed as less capable (Mitchell, Kristovics, & Vermeulen, 2005) or for fear of being sexualized (Davey & Davidson, 2000).

There is a subtle, yet definite, transition between mirroring and gaslighting—a form of psychological manipulation in which one person or group sows seeds of doubt in another person or group in order to cause them to question or doubt themselves or their reality. Gaslighting is a social phenomenon that is particularly "effective when it is rooted in social inequalities, especially gender and sexuality, and executed in power-laden intimate relationships" (Sweet, 2019, pg. 852). Flight deck crew environments exemplify a *power-laden relationship* both in the institutional hierarchy granted by the industry (Captain vs. First Officer) and through social power structures.

When, in response to tensions from race and gender bias in the flight deck, women aviators mirror the male pilot prototype, they justify their mirroring with comments such as "I'm a pilot first and a woman second" (Perkins, Merola, Ghosh, & Aragon, 2024) or "It just makes me have to work harder" and "it's okay" (Zirulnik & Orbe, 2019, pg. 86). I argue that assimilation has transitioned to gaslighting (Sweet, 2019).

Gaslighting is fueled by inequitable structures and spread by distributed cognition (across members of a social group, through environmental structures, and adapted over time) that reinforce the social power structures subjugating women to out-group, subordinate members. The hostility the out-group experiences forces women to further adopt the in-group's identity—perhaps even against their affective or cognitive will—as a strategy to assimilate; and the gaslighting culture cycle continues.

In aviation, female pilots, especially those of color, may assimilate by mirroring male-dominated norms to avoid hostility. This behavior involves making their cultural identity less visible and is a response to gender and racial biases. The practice can evolve into gaslighting, where the dominant group undermines the reality of the subordinate group, a manipulation entrenched in social inequalities. This toxic dynamic is further sustained by the industry's hierarchical and social power structures,

compelling women to assimilate, often against their own beliefs, perpetuating a cycle of gaslighting.

4.6 Deepening the Analysis

The hegemonic power of the pilot prototype is experienced by women pilots in various ways. In a report from the International Aviation Women's Association (IAWA) and Oliver Wyman, a survey of 450 pilots revealed that 59% of females considered leaving the industry due to implicit bias and/or discriminatory behavior (Oliver Wyman & International Aviation Women's Association, 2021). While this survey indicates a potential exodus of female employees, we can empirically substantiate the phenomenon by examining the statistical data pertaining to the retention rates of female pilots. Female aviators comprise 14.2% of student pilots (Women in Aviation, 2020) but a mere 3.6% of airline captains (Federal Aviation Administration, 2022) which clearly indicates women enter the industry but do not stay. The disparity between the percentage of female student pilots and airline captains is significant because it highlights a systemic issue within the aviation industry: women are entering the field but not advancing to or remaining in top-tier positions. This discrepancy suggests potential barriers to career progression for women, which may include, but are not limited to, organizational culture, lack of mentorship, or work-life balance challenges. Understanding why women are not staying or advancing in the industry is crucial for developing targeted interventions to improve gender diversity and equity at all levels of aviation.

Those who stay in the industry may endure gender harassment. Gender harassment can be observed when hostile beliefs about women are conveyed through crude comments or jokes (Kaiser, Bandt-Law, Cheek, & Schachtman, 2022). We see gender harassment revealed in explicitly hostile comments such as, "another empty kitchen" (Mitchell, Kristovics, Vermeulen, Wilson, & Martinussen, 2005) and in benevolent sexist (Glick & Fiske, 1997) comments, such as, *'Well done, you landed just like a man'* (Yanıkoğlu, Kılıç, & Küçükönal, 2020, p. 4). Both types of gender harassment are examples of a negative microculture in the flight deck. The persistence of gender harassment within the aviation industry, manifesting through both overtly hostile and benevolently sexist rhetoric, reflects and reinforces a negative microculture in the flight deck, which has profound implications for the retention, well-being, and professional equity of female aviators.

Additionally, gender harassment can occur during training events, which we also label as a negative microculture because it occurs between small groups of pilots who comprise a crew. For example, a woman at a major air carrier spoke up about the sexist language used during a simulator training session and was told, "if you want to play in a man's world you will have to get used to man's talk" (Davey & Davidson, 2000, p. 198).

4.6.1 Stereotype Threat & Self-Fulfilling Prophecies

Women experience gender harassment and bias in the microculture and report feeling that they must hide their femininity (Yanıkoğlu, Kılıç, & Küçükönal, 2020) and

avoid emotion (Mitchell, Kristovics, & Vermeulen, 2005). They are often exposed to stereotype threat (Siy & Cheryan, 2016) making them feel as though they must work twice as hard for half the credit (Zirulink & Orbe, 2019). A female pilot, cognizant of the stereotype questioning her competence based solely on her gender, might experience increased stress and anxiety. This emotional burden could potentially distract her from her usual routines or decision-making processes, ironically increasing the likelihood of a mistake, thus creating a self-fulling proficiency (Chen & Bargh, 1997).

The pressure to perform flawlessly, to prove the stereotype wrong, not only places an unfair burden on female pilots but also diverts mental resources away from the primary task, affecting performance. Such experiences underscore the pervasive impact of stereotype threat, where the fear of validating a negative stereotype can have tangible consequences on individuals' performance, well-being, and career progression in fields where they are underrepresented or stereotypically viewed as less competent.

Those not exposed to the stereotype threat (men) experience a performance boost called stereotype lift – a social psychological phenomenon where individuals belonging to a group not targeted by a negative stereotype experience an improvement in performance due to the contrast effect of the stereotype. (Walton & Michael Politano, 2014). While men enjoy the performance boost, women experience an increased mental toll of gender bias (Salvatore & Shelton, 2007), cognitive cost of stereotype threat and elevated opportunity for self-fulling prophecies.

In summary, in the aviation industry's gendered microculture, female pilots are compelled to suppress femininity and emotional expression, a behavior intensified by the stereotype threat that undermines their perceived competence and necessitates overperformance (Yanıkoğlu, Kılıç, & Küçükönal, 2020; Zirulink & Orbe, 2019). This heightened state of vigilance, aimed at countering gender-based assumptions, may ironically precipitate the very errors it seeks to avoid, a manifestation of self-fulfilling prophecies that impede objective assessment of female pilots' capabilities (Chen & Bargh, 1997). Meanwhile, male pilots, unencumbered by such stereotypes, may experience stereotype lift, thus amplifying performance disparities not based on actual ability but on the cognitive and emotional toll exacted by systemic gender biases (Walton & Michael Politano, 2014; Salvatore & Shelton, 2007).

4.6.2 Stigmatization & A Lack of Allyship

Stigmatization requires two fundamental attributions: the recognition of differences and the devaluation based on those differences (Bos, Pryor, Reeder, & Stutterheim, 2013). Much of the gender-specific aviation research thus far (see McFadden, 1996; Baker et al., 2001; Vermeulen & Mitchell, 2007) compares how female aviators are different than male aviators, positioning men as standard and subjugating women as a stigmatized *other* status.

Stigmatization functions to maintain the status quo by enforcing social norms (Bos, Pryor, Reeder, & Stutterheim, 2013). Eliminating stigmatization in any context, including the workplace or broader society, often requires the active participation of allies—individuals or groups who support and stand up for the rights and dignity of stigmatized populations. Allyship plays a crucial role in reducing stigma by challenging

the stereotypes and prejudices that underpin it. Unfortunately, recent academic allyship research reveals that most members of the dominant group (male pilots) are not actively participating in allyship.

A 2020 poll of men pilots (n=582) revealed disappointing findings in terms of male pilot allyship (Perkins, Merola, Ghosh, & Aragon, 2024). The research findings elucidate that a significant majority of the survey participants, comprising 64% (n=368), do not perceive the gender imbalance within their industry as a personal concern, hence they refrain from contributing to corrective measures. A minority of 17% (n=96) acknowledged their role as allies, actively engaging in initiatives to mitigate gender disparities. Meanwhile, 12% (n=69) of the respondents expressed a willingness to support such efforts, albeit hindered by uncertainty regarding effective intervention strategies. Finally, 7% (n=40) attempted allyship but experienced discomfort in the process, reflecting a potential need for guidance and structured allyship programs (Perkins, Merola, Ghosh, & Aragon, 2024).

The data indicates a troubling gap in allyship within the industry, with a majority of respondents disassociating from the responsibility to address gender imbalances. This apathy undermines collective efforts to foster equity and demonstrates a lack of recognition of the benefits that diversity brings to the workplace. Furthermore, the small percentage of potential allies feeling uncertain or uncomfortable about their role suggests a significant barrier to effective allyship. Without a more significant number of engaged allies, especially from those within the dominant group, and without proper education and support for those willing but unsure, allyship efforts are likely to be insufficient to catalyze meaningful change, thereby perpetuating the status quo of gender imbalance.

4.6.3 Social Power

The aviation industry has a masculine discourse (see Davey & Davidson, 2000; Walton & Politano, 2014; Yanıkoğlu, Kılıç, & Küçükönal, 2020), that is, a male language, or system of statements, concepts, and ideas, that shape the aviation industry. As a consequence of this, women, as out-group members, report feeling they are treated unfairly—and they are perceived as less competent because of their gender (Mitchell, Kristovics, & Vermeulen, 2005). In addition, since social power is derived from one's relationship with others (Galinsky, Gruenfeld, & Magee, 2003) male aviators have more social power relative to female aviators.

4.6.3.1 The Negative Consequences of Power

Power can decrease empathy and compassion; it can dehumanize people by making the powerful feel less concerned with the suffering of others (Lammers, Galinsky, Dubois, & Rucker, 2015). The detrimental impact of power dynamics may contribute to the observed phenomenon where a substantial majority (64%) of male pilots fail to acknowledge the gender imbalance within the industry as an issue warranting their engagement in allyship efforts.

The dehumanization byproduct of power may also help to explain why pilots, in general, score lower on trait emotional intelligence than the general public (Dugger, Petrides, Carnegie, & McCrory, 2022). Controlling for age, gender, ethnicity, and educational experience, pilots scored lower on well-being, self-control, emotionality, and sociability than the non-pilot group (Dugger, Petrides, Carnegie, & McCrory, 2022).

Along with lowering emotional intelligence and dehumanizing out-group members, overconfidence may be a byproduct of a subjective sense of power (Fast, Sivanathan, Mayer, & Galinsky, 2012). Research finds that overconfidence and underperformance were present when high-power individuals' status was made salient. Men possess the majority of the institutional and social power in aviation; therefore, their status is made salient in the presence of women.

The attenuation of empathy and compassion among the powerful, which can result in the dehumanization of others, may illuminate why a significant proportion of male pilots disregard the gender imbalance as a personal concern requiring active allyship (Lammers et al., 2015). Furthermore, the intersection of power with overconfidence in aviation's male-dominated hierarchy could exacerbate this neglect of gender equity, with empirical evidence suggesting that the very attributes that confer authority may simultaneously diminish emotional intelligence and sociability, further isolating pilots from the experiences of their peers (Dugger et al., 2022; Fast et al., 2012).

In the *Sociology of Gaslight* (2019), Sweet explains, "when perpetrators mobilize gender-based stereotypes, structural inequalities, and institutional vulnerabilities against victims with whom they are in an intimate relationship, gaslighting becomes not only effective, but devastating" (pg. 852). Aviation is fraught with gender-based stereotypes distributed through artifacts (e.g., the abundant use of masculine pronouns in SOPs, and masculine uniforms) and structures (e.g., masculine defaults) that have morphed throughout time. In the context of aviation, the pervasive presence of gender-based stereotypes, as reflected in language and attire, alongside entrenched masculine defaults within procedural and organizational frameworks, serves to perpetuate structural inequalities.

4.7 A Model of the Negative Aviation Culture Cycle that Perpetuates Bias and a Lack of Allyship

The ensuing section (section 4.7.1) is an excerpt from work authored by Dr. Rachael Merola, Sourojit Ghosh, Dr. Cecilia Aragon, and myself in: Perkins, K., Merola, R., Ghosh, S., Aragon, C. (2024). "'I'm a Pilot First, Female Second': Why Flight Deck Gender Imbalance Persists and the Case for Allyship." *Journal of Aviation/Aerospace Education and Research.* I offer a condensed version here as the research is invaluable to the broader discussion of this dissertation.

4.7.1 Culture and the Failure of Diversity Training

Adding to the negative culture is the prevalence of treating women as "tokens" or "diversity hires." The WIAAB report (Federal Aviation Administration, 2022) defines

tokenism as “the practice of making a perfunctory or symbolic effort to do a particular thing, especially by recruiting a small number of people from underrepresented groups to give the appearance of sexual or racial equality” (p. 53). The report concludes that the lack of inclusivity is rooted in “false perceptions of equality, a credibility gap, gender stereotypes, bias, harassment, and tokenism” (p. 46).

Currently, companies and flight organizations rely on unconscious bias training as a lever to change the culture. Nearly all Fortune 500 companies offer some sort of diversity or unconscious bias training (Dobbin & Kalev, 2018). However, research shows this training to be largely ineffective (Lai et al., 2016) and even when effective, changes were short-lasting (Lai et al., 2016; Forscher, Mitamura, Dix, Cox, & Devine, 2017). Bias training can make participants defensive and less inclined to change behaviors (Howell, 2013; Knowles, 2014). Additionally, framing bias as “implicit” rather than “explicit” can serve to mitigate culpability, unintentionally undermining the desired effect of the training.

Some research supports exposing in-group members to the stigmatized out-group as a method for curbing unconscious bias (Pearson, Dovidio, & Gaertner, 2009). This approach can be effective for changing sentiment toward women pilots, as shown in Walton and Politano’s (2014) study indicating that men pilots with the strongest opposition to women pilots tended to be those that did not frequently occupy a gender-diverse flight deck. When men pilots shared the flight deck with a woman pilot 75% of the time, they viewed women pilots as having “nearly equal status” (Walton & Politano, 2014). However, given the low representation of career women aviators, using exposure as a method to curb gender bias is likely an ineffective plan– other interventions are needed.

4.7.2 Results: Hostility Toward Women and Problem Denial

Overt manifestations of sexism, evidenced through explicit discriminatory behaviors and language, continue to prevail. The research by Perkins, Merola, Ghosh, and Aragon (2024), which examines voluntary submissions on a social media platform, provides empirical substantiation for the claims presented in preceding subsections. Furthermore, this study incorporates direct testimonials from female aviators, thereby enriching our understanding of stereotypes, stigmatization, and harassment within the context of their authentic experiences.

In some cases, there were implications that they were too attractive for their current profession, or that they were not attractive enough for others. Women pilots recounted comments such as “You're too pretty to fly planes, you should do porn instead,” indicative of the belief that physical appearance should be a factor in their professional choices.

Some women aviators felt their femininity presented an excuse for men to talk about their bodies, and received comments such as, “Did you break a hip? No? Then why are you swinging that ass like that?” Finally, a few women recounted instances of male pilots insinuating that they had used sexual favors to get their credentials, having heard comments such as, “When I first saw you, I assumed you'd just gotten by

because you were cute." Through these comments, hostile sexism manifests on the flight deck.

However, this is not the only form of sexism we identified, as there was another that can be equally if not more dangerous: benevolent sexism. Such sexism persists as a kinder, more subtle, nudge to maintain male dominance. Benevolent sexism can be difficult to identify, since individuals harboring and perpetuating benevolent sexism may believe their gender assumptions and related actions are altruistic. Benevolent sexism can appear through complementary gender differentiation (Glick & Fiske, 1997), such as "I always loved working with female pilots. They were generally more energetic, sharp, and harder workers." While a comment like this may seem positive, gender differentiation assigns traits to women that are consistent with and thus promote traditional gender roles where women are consistently in a position of less status and power (Glick & Fiske, 1997).

Women pilots experience these nudges toward traditional 'homemaker' roles through benevolent sexist reminders that they are the gender responsible for caregiving roles, such as the following poll comment: "I do believe this career can make it EXTREMELY difficult to be a mother, and that pushes some women away from or leads to the exit of some from this profession. Not because they can't perform the job well, but the sacrifices required are too great for their individual desires and risk/reward proposition." While these forms of benevolent sexism may appear approving or supportive, they work against egalitarian inclusivity. Both hostile and benevolent forms of sexism serve to validate and preserve patriarchy (men's structural control) and maintain the defaults, stereotypes, and prototypes that contribute to the negative culture felt by non-prototypical pilots (Glick & Fiske, 1997).

Problem Denial was also a theme in many comments. Multiple respondents who chose to leave a comment from the Group B poll denied there is a gender problem in aviation, for example, "Just like in any career, this is an equal opportunity for anyone who wants it." Some comments argue against programs that favor women and claim men are the marginalized gender; for example, one male pilot wrote, "I'm confused, I was under the impression that woman [sic] have an advantage in aviation?" Another wrote, "I hate to tell you this but between affirmative action programs and hiring quotas. Women have always had the advantage in aviation."

Comment analysis revealed gaslighting, a recurring phenomenon akin to a variation of problem denial. Comments including gaslighting varied in their severity but held the underlying theme of problem denial, as can be seen in the following examples:

> Comment 1: "Have you thought just for once that a majority of women don't want to be pilots? Hmmmm... what a thought."
> Comment 2: "All careers are self-selective. No institution or group is keeping women out. Men and women are different creatures and in fact like different things. Women can pursue aviation just as men can and their trajectory in any career is based upon desire, drive, and motivation. Look at careers where there are more women than men. Nobody is keeping men out. It just happens that men and women gravitate to different things. Time to accept that as a fact and stop demanding that everything have 50/50 numbers."

> Comment 3: “Do women need allies? Is there something blocking you from getting a career in any STEM field?”
> Comment 4: “The fact that this is even a topic surprises me. We will hire the person, not the gender as it’s more important to be safe than [sic] politically correct.”
> Comment 5: “Last I checked, I got my ratings and survived the check rides by meeting the criteria for a pass. I’d prefer having mentors and people who believe in my abilities - than an ‘ally’ cause of lady bits. Sincerely- a woman.”

The last comment, made by a female pilot, exemplifies *conformity for social capital*. In cases like these, women pilots may adopt what they perceive to be desirable traits associated with the prototype pilot or attempt to assimilate into the culture established by the collective norm (Zirulnik & Orbe, 2019). Conformity for social capital is also observed through a comment left by a woman pilot who claimed that men pilots are “usually ‘out-guyed’ by me because I am and will always be a tomboy and it ends up being a good situation. I just don’t go around trying to prove myself because I’m a chick. I’m a pilot first, female second.” The comment shows assimilation to align with the hypermasculine pilot prototype.

A third theme can be seen in a variety of the definitions and perceptions of allyship. One pilot suggested his allyship consisted of “not being creeptastic – which was a common complaint among female students across all the flight schools I worked at.” This pilot stated, “I was one of two male instructors at a school I worked at that female students specifically requested because I don’t give a [expletive] what’s between your legs, I care if you meet the standard.” This comment reveals a belief that simply not participating in harassment is akin to helping remedy it.

Seventeen percent of male pilots reported they were “actively doing something” to help end discrimination. Comments suggest that in some cases, their involvement was simply to hire women pilots; for example, one pilot wrote he was “fully supportive of women in aviation,” and volunteered that he had “hired and worked with several in the corporate arena over the years.” Another pilot noted that he had “hired a female pilot who became a Captain this would be about 1985 era.” The datedness of these comments and the paucity of examples suggest that some men pilots believe a one-time act of support is sufficient to characterize themselves as lifelong allies of women pilots. As one woman pilot eloquently expressed that her concept of allyship went beyond simply hiring women:

> I think for me personally (not speaking for every female pilot here) – being an ally is stepping up and taking ACTION when you see wrongdoing. So, if you see a female pilot being harassed – it’s stepping in. When you see your friends making jokes that are sexist and inappropriate, it’s speaking up. I was discriminated against multiple times at an old workplace – people knew about it and did nothing. They stayed silent. And who wins when it’s one voice against a company? Being an ally isn’t just saying “I have female pilot friends” or “yeah women should be pilots!” – it’s also recognizing that we experience a different

side of this industry and stepping up when you see someone not being treated fairly. When you see something – say something.

The persistence of overt sexism in the aviation industry, as demonstrated through discriminatory language and behavior, is a significant impediment to achieving gender equity. This is substantiated by research that includes firsthand accounts of female aviators, elucidating the prevalence of stereotypes and the stigmatization they endure, which is further complicated by the presence of benevolent sexism. Such sexism, while outwardly appearing affirming, covertly reinforces traditional gender roles and maintains structural gender inequalities. Additionally, the denial of gender issues in aviation, often manifested as gaslighting, serves to preserve the status quo of power imbalances, minimizing the lived experiences of women in the field. The varied understandings of allyship, ranging from a passive avoidance of overt harassment to proactive intervention and advocacy, highlight the need for a deeper, more consistent commitment to allyship within the industry.

4.7.3 Discussion on the Negative Culture Cycle

The excerpt from Perkins, K., Merola, R., Ghosh, S., Aragon, C. (2024). "'I'm a Pilot First, Female Second': Why Flight Deck Gender Imbalance Persists and the Case for Allyship." *Journal of Aviation/Aerospace Education and Research* continues below.

We found ample evidence of women pilots experiencing gender harassment and exclusionary behavior in the workspace, both from their own anecdotes and from men's direct comments. The finding that 65% of women pilots had reported being called 'tokens' or 'diversity hires' adds to existing evidence that women pilots experience sexism, high visibility, scrutiny, less favorable advancement, and harassment, all of which results in their leaving (or causes them to leave) the airline industry. This is supported by the finding that 24% of women pilots believed that the negative culture was the biggest barrier to recruiting more women in the aviation industry, a finding also substantiated by the WIAAB Report (2022).

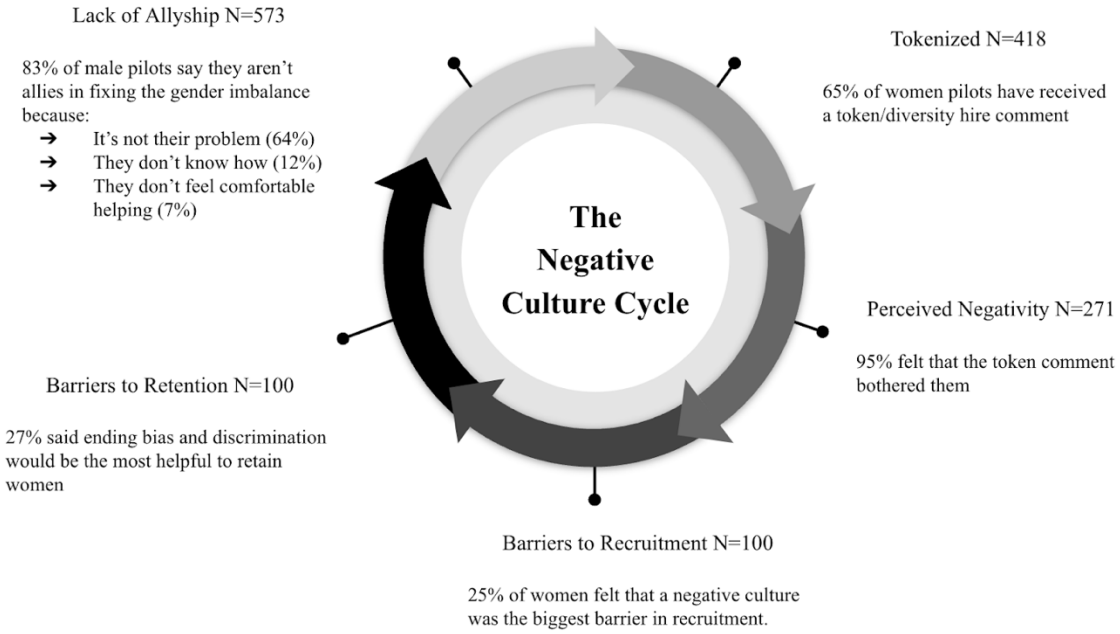
Findings indicate that microaggressions in the form of tokenizing diversity—that is, hiring from underrepresented or marginalized groups in order to give the appearance of diversity but not make any real changes—are commonplace and that they negatively impact the culture in the workplace. Microaggressions and toxic workplace culture also impact the perception of the industry as a whole, which contributes to the low recruitment and poor retention rates of women in aviation (Oliver Wyman & International Aviation Women's Association, 2021).

The lack of allyship in conjunction with the frequency of negative comments illuminates why a negative culture persists. Allyship offers a powerful voice for the underrepresented group. Men benefit from their in-group status in various ways, including favoritism (Brewer, 1999), stereotype lift (a boost in performance by negatively stereotyping out-group members) (Walton & Cohen, 2003), and the alleviation of the cognitive cost associated with stigmatization (Salvatore & Shelton, 2007). These advantages are available to men pilots because of their identity (Radke, 2020) as opposed to those earned through a meritocracy. A true ally is someone who is aware of

these advantages and uses them to create a more egalitarian environment. For men to become an ally, they must first acknowledge these advantages and then leverage their power to create a more inclusive environment.

Our research shows that the perpetuation of a discriminatory workplace for non-prototype pilots contributes to a reduction in psychological safety, which reduces the efficacy of safety models and systems utilized within the industry (Perkins, Ghosh, Vera, Aragon, & Hyland, 2022). The hegemony of this culture explains why the majority of men pilots do not feel compelled to ameliorate the inequities; thus, leaving the burden of problem-solving the gender imbalance on the marginalized group. Women who enter the aviation industry are often tokenized, which is one way a negative culture is created. A negative culture is a barrier to retaining these women as well as a barrier to recruiting future women aviators. Many men pilots do not see this negative culture cycle as their problem to resolve. We depict this concept in Figure 4.7.3.

Figure 4.7.3
A Model of the Negative Culture Cycle that Perpetuates Gender Bias in Aviation



4.7.4 Concluding Thoughts for the Remedy of an Exclusionary Culture

To resolve the gender imbalance, the industry has been reliant on i-frame interventions that operate under the premise that individual (i.e., mentorship, volunteerism) and organizational (e.g., International Aviation Women's Association, The Ninety-Nines, Women in Aviation, etc.) efforts will resolve the gender imbalance. Although the merits of such approaches are clear, current statistics have shown they are not enough on their own. S-frame solutions should include required advanced

interpersonal skills education, competency-based training with observable behaviors as metrics for success, and the setting of measurable goals on the intervention outcomes.

This study provides evidence of the prevalence and impact of modern-day gender-based bias in the professional aviation industry in the United States. Results support our argument that prejudice in the industry is rooted in socially constructed biases manifested through masculine defaults, prototypes, and stereotypes: 53% of comments expressed negative sentiment regarding the presence of bias, commonly containing gaslighting (Sweet, 2019). Our results provide evidence that the systemic bias in aviation negatively impacts those considering a career in aviation and those already in the industry. Sixty-five percent of women pilots have been called a token or diversity hire. Furthermore, this research fills a gap on the role of allyship in aviation. The majority of men pilots (83%) do not participate in allyship mainly because they do not feel that the gender imbalance is pertinent to them (64%), which elucidates why a negative culture in aviation exists.

The presence of such a culture cannot be ignored, nor can industry executives and policymakers turn a blind eye to how it is being perpetuated. There is an immediate need for a culture shift, and traditional unconscious bias training is not working (Dobbin & Kalev, 2018). Current approaches to end bias, such as ‘copy-and-paste’ unconscious bias training can be divisive and generate an “us” vs. “them” narrative; more thoughtful and personalized approaches are needed. The culture shift must be part of a wider program of change, such as integrating it from the first stages of pilot training to solidifying it with annual recurrent training. We propose such a program in chapters 8 and 9 of this dissertation. We can dismantle the negative culture for non-prototype pilots by integrating a more inclusive culture as a necessary shift for the overall health of the industry and the next generation of aviation professionals.

The entrenched negative culture cycle within the aviation industry perpetuates gender bias, necessitating a paradigm shift towards inclusivity to ensure the psychological safety and retention of non-prototype pilots. This cultural shift is imperative not only for rectifying present disparities but also for securing the industry's future by creating an environment that is conducive to the recruitment and empowerment of the next generation of aviators. Such transformation requires a concerted effort that moves beyond traditional bias training to systemic changes in industry practices, including the promotion of true allyship and the implementation of interventions with measurable outcomes.

4.8 What Women Can Tell Us About Improving Safety Models

The Crew Resource Management/Threat and Error Management (CRM/TEM) paradigm predicates its success on the assumption that communication among flight crew members is a constant free exchange of safety-critical information. Research substantiates that information dissemination is compromised in environments devoid of psychological safety, suggesting a pressing need for industry-wide mandatory training in bias awareness, psychological safety, and advanced interpersonal communications (Perkins, Ghosh, Vera, Aragon, & Hyland, 2022). It is advocated that aviation

professionals demonstrate a mastery of the interrelation between bias and communicative efficacy as it pertains to the establishment of psychologically secure flight decks. This entails training for managerial personnel and facilitators to employ both prescriptive and descriptive measures of observable behavior, such as Line Operations Safety Audits (LOSA), within flight deck and simulator settings to assess and enhance pilot proficiency in interpersonal skills. The envisaged primary outcome of such training initiatives is the development of a pilot cadre endowed with a growth mindset, heightened emotional intelligence, and the aptitude creating psychologically safe flight decks. Concurrently, a secondary ambition is the creation of a workplace where diversity is actively embraced, fostering an atmosphere of inclusivity.

4.8.1 Insights from Women Aviators on Pilot Resiliency Training

Further exploration into the resiliency (see Chapter 3) of women and other minority groups in aviation may provide tools for how best to implement resilience training for pilot groups at large. Women aviators have been required to demonstrate graceful extensibility (e.g., resilience (Wood, 2015)) to function in their jobs. As women navigate a cornucopia of external threats (gender bias, harassment, discriminatory out-group behaviorism, to name a few), they have had to build resiliency in order to succeed in a negative workplace culture. Their capacity to adapt is extensive. Further research may explore the specific strategies utilized by women aviators (or any non-prototype pilot) as potential training material for pilot resiliency education as part of advanced interpersonal skills training.

4.8.2 DEI Training is Part of Safety Training

Utilizing the synthetic data on pilot error, we can assume there are more than 36 million annual pilot errors and over 1 million instances of pilots self-muting or self-silencing (see Chapter 3). The acceptable level of safety should not be measured in catastrophic accidents; we must look at ways to reduce pilot error. Interpersonal skills training is a viable path toward reducing the frequency of muted safety voices and safety silence.

People tend to act in ways that would inhibit learning from failure or speaking up when they feel a threat (Edmondson, 1999). Those not identifying with the pilot prototype are perpetually under threat from out-group hostility. Meanwhile, the presence of non-prototype pilots makes the dominant group's social power salient, potentially spurring the negative consequences of power and elicit the cyclic phenomena of mirroring and gaslighting. We can disrupt this cycle by spotlighting the shared common goal of safety.

Safety is a common goal shared by all pilots regardless of power structures or in-group/out-group dynamics. Focusing on enhancing safety by strengthening the processes necessary for the distributed cognition within the socio processes of the sociotechnical system (i.e., the flight deck) removes the threat response elicited by in-group/out-group dynamics.

The industry can benefit by understanding the lived experiences of women pilots and their resilience to overcome hostile work environments. We can start to reduce out-group hostility and leverage the safety advantages of dismantling non-egalitarian power structures. For this reason, the industry has much to learn from women aviators that will enhance safety through improved safety models. By recontextualizing bias literacy training within the scope of safety training, the approach transitions from an individual-based appeal to a systemic, obligatory directive.

4.9 Chapter Conclusion

This chapter delved into decades of academic research documenting the experiences of women aviators. Notably, it highlighted how the negative culture encountered by female pilots may resonate with other marginalized groups, particularly as intersectionality compounds the challenges faced by Black women aviators dealing with both sexism and racism.

Drawing from concepts in social psychology, the chapter elucidated how the aviation industry perpetuates a masculine prototype as the ideal pilot through masculine defaults. Women often find themselves assimilating or facing a double bind, attempting to uphold the ideal prototype while navigating feminine stereotypes.

Exploring social power dynamics within in-group membership, the chapter examined how negative consequences contribute to a lack of allyship. Phenomenological insights gleaned from the experiences of women aviators across decades provide a valuable understanding of the interpersonal skills required to foster inclusivity and psychological safety.

The groundwork laid here is essential for developing strategies to identify and mitigate risks associated with safety silence and muted voices in the flight deck, thus advancing aviation safety protocols. Overall, this chapter sets the stage for a deeper investigation into how the aviation industry can evolve to address critical safety and cultural challenges.

Chapters 3 and 4 were employed for conducting a literature review to construct a framework for analyzing interpersonal skills and identifying areas of improvement within the industry. We now transition from previously conducted research to new research that comprises this dissertation. Chapter 5 outlines the methods utilized in the research. Chapters 6 through 7 detail the findings. Chapter 8 discusses the future of interpersonal skills training to address the safety-silence problems identified in Chapter 3 and culture issues identified here. Chapter 9 discusses next steps and suggests avenues for future research.

Chapter 5 - Methods

5.1 Chapter Overview

The preceding chapters have laid the foundation for examining interpersonal skills and their implications in bolstering safety and fostering diversity within the aviation sector. The subsequent chapters will focus predominantly on the research conducted for the dissertation. The study involved training 1600 pilots over a two-day period using a lecture-based intervention, with data collection conducted through three surveys and semi-structured interviews.

This research seeks to improve the CRM/TEM model by addressing its reliance on the mistaken belief that psychological safety is always present in the flight deck. Chapter 3 introduces three academic concepts—bias literacy, psychological safety, and interpersonal communication—as potential tools to enhance interpersonal skills in this setting, termed 'advanced interpersonal skills'. The study aims to measure initial understanding and attitudes towards these concepts and assess whether a training intervention can increase understanding and positive attitudes towards them, as shown by endorsement of the training.

This chapter outlines the methods used to address each research question, which can be referenced in section 1.7 of this dissertation. Research questions were categorized as confirmatory or exploratory, guiding the choice of methodology (Corbin & Strauss, 2008). Both quantitative and qualitative data (Bernard & Ryan, 2010) were used as part of the mixed method design.

5.2 Participants

Participants for data collection were selected from a major United States airline, including line check pilots (LCPs), pilot instructors (PIs), evaluators, and flight-qualified managers (FQMs). These individuals possess substantial experience in Crew Resource Management (CRM), Threat and Error Management (TEM), and standard operating procedures (SOPs) within the company. They also assume additional responsibilities in training or managerial roles. For the study's purposes, these roles are collectively referred to as 'Pilot Safety Leaders' (PSLs).

5.2.1 The Intervention Setting

As a requirement of their positions at the company, Pilot Safety Leaders (PSLs) are obligated to participate in the airline's annual symposium, termed the "Standards Meeting." This three-day meeting disseminates organizational knowledge with an emphasis on safety-centric trends, issues, and developments.

Because of the large size of the PSL group (approximately 1,600), the airline structured the assembly into four distinct cohorts, with each group convening in person sequentially over a period extending from August to October 2022. For tracking clarity,

these cohorts were designated sequentially as Group 1 through Group 4, corresponding with the chronological order of their meetings.

5.2.2 Participants' Demographics

This section presents the demographic details and experience levels of the pilots gathered from Survey 1. The survey solicited data from pilot respondents concerning their gender, racial identity, flight qualifications (encompassing both total flight hours and duration of occupational tenure), leadership roles (specifically, experience in the capacity of Captain), and the type of aircraft fleet they were currently operating.

By a vast majority, the pilot group consisted of White (89%) men (94%), with Captain experience (95%), more than ten years of operating experience (97%), and more than 5000 flight total hours (94%). Table 5.2.2 offers descriptive statistics for the shareable demographic variables of participants.

Table 5.2.2
Participants' Demographics and Flight Experience

Variable		N value	% of total
Gender	Total	542	100%
	Women	28	5.17%
	Men	511	94.28%
	Non-Binary	3	0.55%
Race	Total	520	100%
	Black or African American	25	4.81%
	Latinx or Hispanic	11	2.12%
	White	464	89.23%
	Asian	5	0.96%
	Multiracial	15	2.88%
Tenure - Years	Total	610	100%
	0 - 5 years	7	1.15%
	6 - 10 years	10	1.64%
	11 - 15 years	31	5.08%
	16+ years	562	92.13%
Tenure Flight Hours	Total	608	100%
	1500 - 3000 hours	6	0.99%
	3001 - 5000 hours	28	4.60%
	5001 - 10,000 hours	110	18.09%
	10,000+ hours	464	76.32%
CA Experience	Total	609	100
	Yes	577	94.75%
	No	32	5.25%

A challenge in capturing demographic and flight experience data was that the data gathering relied on the PSLs volunteering to complete Survey 1, as it was not required by the company (only about half of the 1,600 PSLs completed the survey; see subsection 5.3.4 “Survey Response Rates and a Taxonomy of Data Utilization in the Study” for survey response rates). Additionally, roughly 200 people who completed Survey 1 left the demographic questions unanswered. However, since the race and gender characteristics of PSLs mirror national averages for professional pilot demographics across the industry (see Federal Aviation Administration, 2022), I consider the collected data of those who responded to the demographic inquiry as representative of the broader PSL group.

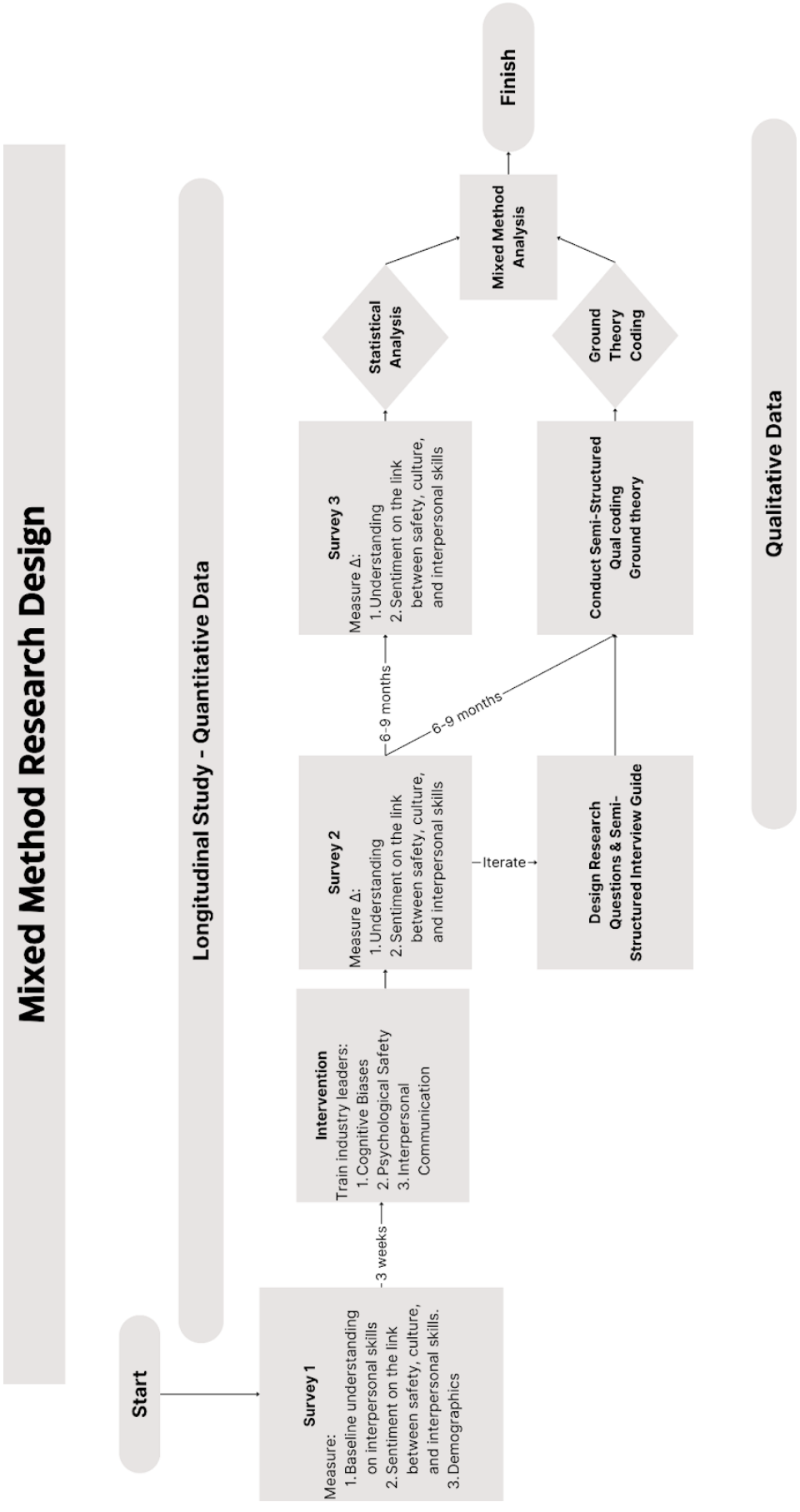
5.3 Study Design - Quantitative Data Collection

The ultimate goal of this research is to enhance the efficacy of the CRM/TEM model. In Chapters 2 and 3, I discuss how the model was built on the incorrect assumption that psychological safety is omnipresent in the flight deck. It is not. Chapter 3 highlighted three academic concepts (bias literacy, psychological safety, and interpersonal communication) as resources that could be utilized to enhance interpersonal skills in the flight deck. These three concepts will collectively be referred to as ‘advanced interpersonal skills’ as they go beyond the current level of interpersonal skills discussion in CRM/TEM training material.

The study was designed to 1) measure the baseline understanding of and attitude toward advanced interpersonal skills concepts; and 2) measure whether a training intervention would increase understanding and attitude (as measured through endorsement of training) with regard to these concepts.

I provide a broad view of the study to orient readers to the sequence of data collection and analysis. Figure 5.3 provides a pictorial representation of the study design. The intricacies and details of each section are discussed thoroughly in subsequent sections. Broadly, Survey 1 was made available to all participants to measure understanding and attitude of the three interpersonal skills concepts before an intervention. Then a training intervention was implemented. Surveys 2 and 3 re-measured understanding and attitudes after the intervention. Semi-structured interviews were conducted after all survey data was collected.

Figure 5.3
Dissertation’s Research Design Overview


Mixed Method Research Design
Start
Longitudinal Study - Quantitative Data
Survey 1
Measure:
1. Baseline understanding on interpersonal skills
2. Sentiment on the link between safety, culture, and interpersonal skills.
3. Demographics
3 weeks
Intervention
Train industry leaders:
1. Cognitive Biases
2. Psychological Safety
3. Interpersonal Communication
Survey 2
Measure Δ:
1. Understanding
2. Sentiment on the link between safety, culture, and interpersonal skills
Iterate
Design Research Questions & Semi-Structured Interview Guide
6-9 months
Survey 3
Measure Δ:
1. Understanding
2. Sentiment on the link between safety, culture, and interpersonal skills
6-9 months
Conduct Semi-Structured Qual coding Ground theory
Statistical Analysis
Ground Theory Coding
Mixed Method Analysis
Finish
Qualitative Data

5.3.1 Quantitative Data Instrumentation

The instruments utilized in collecting the quantitative data were three surveys administered over the course of a 12-month time period. All data was collected between August 2022 and July 2023. Survey 1 (S1) was offered to all participants prior to attending the Standards Meeting. Survey 2 (S2) was offered immediately after the lecture-based training intervention, and Survey 3 (S3) was distributed six to nine months post-training intervention.

The three surveys aimed to assess pilot experience, measure baseline understanding and attitude towards interpersonal skills, evaluate the impact of training on understanding and attitude, and investigate longitudinal changes in perception regarding the usefulness and implementation challenges of advanced interpersonal skills in aviation training.

The surveys were structured as follows:

Survey 1:

- Questions 1-4 gathered pilot experience details (e.g., total flight time, Captain experience, tenure as a professional pilot).
- Questions 5-7 focused on previous CRM/TEM training.
- Questions 8-12 assessed baseline understanding of three advanced interpersonal skills and endorsement of FAA-recommended skills.
- Question 13 solicited participants' opinions on the benefits of training on these concepts for overall safety.
- Questions 14-17 collected demographic data (gender, race, LGBTQ+ status, etc.).
- Question 18 inquired about interest in participating in the Harvard Implicit Association Test. This survey was distributed before the Standards Meetings.

Survey 2:

- Questions 1-6 were identical to Survey 1's questions 8-13 to measure post-training impacts.
- Questions 7-8 gauged participants' beliefs about the relevance of interpersonal skills to their pilot role and previous training in these skills.
- Questions 9-12 were open-ended, prompting participants to discuss challenges in implementing advanced interpersonal skills and their perceived usefulness.
- Question 13 asked about willingness to participate in future interviews. This survey was distributed immediately after the training intervention.

Survey 3:

- Questions 1-5 mirrored Survey 1's questions 8-12 and Survey 2's questions 1-5 to track longitudinal changes.

- Questions 6-7 prompted reflection on past experiences and the efficacy of interpersonal skills training.
- Questions 8-9 asked for opinions on the best methods to measure effective interpersonal skills training.

5.3.2 Longitudinal Study

As briefly mentioned above, the three surveys had five identical questions designed to track changes in responses over a six to nine-month period. This length of time was intended to mimic that airline's recurrent Advanced Qualification Program (see Federal Aviation Regulations §121.901- §121.915) training cycle timeline.

All five questions focused on six interpersonal skills: three FAA-recommended interpersonal skills concepts (leadership adaptability, setting the tone, and demonstrating sensitivity) and three advanced interpersonal skills concepts (cognitive biases, psychological safety, and interpersonal communication). One question focused on all six impersonal skills concepts collectively and asked participants to rate the importance of each in enhancing safety. A five-point Likert scale was utilized along with an additional option for participants to select the choice of, "I don't know what this means." This survey question appeared in all three surveys to assess where there was change in response over time.

The question appeared as Survey 1, Question 8 (S1Q8), Survey 2, Question 1 (S2Q1), and Survey 3, Question 1 (S3Q1). As part of the data cleaning process, each of the six interpersonal skills concepts were condensed into a construct label and referenced as a part number based on the order in which they appeared in the question. For further explanation on how the dataset was organized and the constructs operationalized in the study, please see Appendix C.

5.3.3. Survey Distribution and Participatory Recruitment

All surveys were facilitated via Qualtrics, an online paid survey tool. Survey 1 was distributed as an embedded link in a company email. The email was sent from the airline's Human Factors manager utilizing a listserv of the PSLs scheduled to attend the Standards Meeting. The email encouraged participation before attending the meeting but did not require it.

Survey 2 was made available to participants immediately post-training. The last slide of the day 2 lecture displayed a QR code and a TinyURL connecting PSLs to Survey 2. All participants had a company-issued iPad or personal cell phone to complete the survey. They were afforded 15 minutes to complete the survey while remaining in the conference room, or they were free to complete the survey up to three days post-training.

Survey 3 was sent in the same manner as Survey 1; however, it was sent six to nine months post-training (that is, six to nine months after the concepts were introduced at the Standards Meeting).

To conduct a longitudinal study, survey participants were identified by using a company-created unique code. The researchers did not know the composition of the

unique code. Each survey began by asking participants to enter their unique code. Through this process, we were able to observe any changes in survey responses over time from a single participant. While the unique code allowed us to conduct a longitudinal study with participants remaining anonymous, it presented a challenge as not all participants entered a code on every survey. To best understand the total n value for each survey and the various levels of data collected and analyzed, I created a taxonomy of data utilization.

5.3.4 Survey Response Rates and Taxonomy of Data Utilization in the Study

Not all participants responded to the surveys. Of the estimated 1600 attendees, there were 844 individual responses to Survey 1 (52.75% response rate), 1164 individual responses to Survey 2 (72.75% response rate), and 250 individual responses to Survey 3 (15.63% response rate).

Throughout this thesis, various levels of data are utilized to address research questions. For transparency purposes and ease in comprehending the analysis results, a taxonomy was created to spotlight how data was collected, cleaned, and utilized. The levels of data, their practicality, and relevancy are described below:

- Data Level 1 (DL1): This data was used as descriptive analysis in order to look at groups as a whole. Survey 1 (S1) data utilized Groups 1-4 to establish a baseline understanding of interpersonal skills, attitudes toward and endorsement of the link between culture and safety, and to identify a potential gap in CRM/TEM training.
- Data Level 2 (DL2): Unique codes from S1 Groups 2-4 were matched with unique codes from S2 Groups 2-4. As Group 1 served as a test case for content design, all of Group 1 data was removed. DL2 was utilized to measure whether a 100-minute lecture-based intervention training session impacted PSL's understanding of interpersonal skills and perception of the relevancy of the culture/safety link. Additionally, DL2 was used to measure whether an expectation, recency, or social desirability bias significantly impacted the results of the survey.
- Data Level 3 (DL3): Unique codes from DL2 were matched to S3 responses. This data provided three time points: Time 1 (T1) 1-3 weeks before training, Time 2 (T2) immediately post-training, and Time 3 (T3) 6-9 months post-training. DL3 data was used to measure how time influenced PSLs' understanding and attitude toward interpersonal skills.

The following table represents a taxonomy of the surveys, their distribution timeline, and the number of responses (n value).

Table 5.3.4
Surveys 1-3 Taxonomy with N values

	Survey 1 (S1) Time 1 (T1)	Survey 2 (S2) Time 2 (T2)	Survey 3 (S3) Time 3 (T3)
Data Level 1 (DL1)	N=844	N=1164	N=250
Data Level 2 (DL2)	N=341		
Data Level 3 (DL3)	N=105		

5.3.4.1 Data Cleaning

All quantitative data was cleaned by two independent researchers utilizing different methods (Python and a manual analysis via Microsoft Excel) and then compared for accuracy. Inconsistencies were addressed collaboratively and rectified before the data was interpreted.

On occasion, duplicate unique code entries were noted. This occurred either because an individual PSL attempted the survey multiple times or, on some occasions, attended more than one training session. On these occasions, the first response was kept while subsequent entries were deleted. Incomplete entries were also removed from the data set. Incomplete entries were identified as an empty row of data with only a unique code entry.

5.3.4.2 Designed to Measure Biases

Bias was a concern, particularly with the data collected immediately after training (Survey 2). Academics design research and interventions in ways to predict and circumnavigate common biases. To test whether biases (such as recency, social desirability, and/or expectation bias) had a significant impact on PSLs' responses to the interpersonal skills concepts post-training, I designed Group 4's Survey 1 without mention of the advanced interpersonal skills and then conducted a quantitative statistical analysis.

Group 4, Survey 1 was designed to remove any mention of the three advanced interpersonal skills. Groups 1-3 Survey 1, Question 8 asked, "How important are the following concepts to enhancing safety?" and listed six interpersonal skills concepts (three advanced and three FAA-based). Whereas, Group 4, Survey 1, Question 8 asked the same question with the change in that participants only saw the three FAA-based interpersonal skills concepts (there was no mention of the advanced interpersonal skills). Figure C.1 of Appendix C shows the Groups 1-3 Survey 1 and lists all six interpersonal skills constructs (three from the FAA and three advanced) vs. Group 4, Survey 1 with the advanced interpersonal skills removed, as indicated by a red strike mark.

The design intention was to test whether participants' exposure to advanced interpersonal skills concepts prior to training impacted their responses post-training. To quantify the responses, Likert-scaled answers were given a numerical value. Values ranged on a five-point scale. For the purpose of this research, any blanks or responses selecting "I don't know what this means" were removed from the data. The quantitative values were distributed in the following manner:

5 = Extremely important
4 = Very important
3 = Moderately important
2 = Slightly important
1 = Not at all important

Responses to the FAA-interpersonal skills responses between Groups 2 & 3 (labeled as S1, Q8, Parts 4-6) were compared to the same questions asked of Group 4 (labeled as Survey 1, Question 8, Parts 1-3). To test the hypothesis that these groups responded similarly, and that bias did not significantly influence responses, a Wilcoxon signed rank test was utilized. The test did not reveal any indication of bias. This finding holds significance as it affirms the methodological validity of merging Group 4's dataset with those of Groups 2 and 3 for additional analysis, thereby reinforcing the reliability of subsequent inferential statistics and data analysis. Appendix C contains the detailed results of the Wilcoxon signed rank test for bias.

5.4 Intervention Design

Surveys 2 and 3 served as useful instruments for capturing how Pilot Safety Leaders (PSLs) responded to the following intervention: a 2-part lecture-based training focused on bias literacy, psychological safety, and interpersonal communication grounded in the framework of CRM/TEM.

5.4.1 Intervention Structure

The design of the intervention was limited by the structure of the airline's meeting profile. I was afforded a 20-minute speaking opportunity on day 1 to introduce the topic to all attendees (approximately 400 within each group) and then an 80-minute speaking opportunity on day 2 to provide an educational session.

For that educational session on day 2, the group was divided in half based on each PSLs' assigned aircraft. The choice of the division was outside of my control as it was strategically designed for subsequent company discussions specific to fleet type. Each group consisted of roughly 200 PSLs. Each group received an 80-minute training session consisting of a lecture-based presentation with small group breakout sessions to reinforce concepts. Henceforth, I will refer to this 100-minute, two-day period as "training" or "intervention".

The instructional content was integrated into a pedagogical structure aligned with existing paradigms like Crew Resource Management/Threat and Error Management

(CRM/TEM), using established aviation safety terminology. advanced interpersonal skills concepts were explained using familiar Federal Aviation Administration (FAA) principles, in the language commonly used by professional pilots. This deliberate strategy aimed to make new concepts more accessible by connecting them to the safety framework pilots are already familiar with through conventional CRM/TEM instruction.

5.4.2 Training Material and Presentation Iterations

Prior to the convening of the Standards Meetings, I engaged in preliminary qualitative research utilizing informal focus groups, which were composed of academics and professional aviators. It should be noted that the pilots participating in these focus groups were distinct from those involved in the study's data collection. The insights gleaned from these preliminary discussions informed multiple revisions of the presentation content and format, specifically in balancing the representation of quantitative evidence, such as graphical data and tabular compilations, against qualitative narratives. After thorough preparation and refining the presentation, it was submitted to the airline for evaluation before the Standards Meetings.

During Group 1's training session, I observed how attendees initially responded to newly introduced concepts from social psychology. Immediate reactions were captured through a post-training question-and-answer session. Additionally, an informal social gathering allowed participants to share their reflections directly. A dominant theme that emerged from discussions with Group 1 centered on the nuanced concept of privilege.

In my presentation, I consciously refrained from explicitly mentioning “privilege” and opted, instead, to encapsulate the idea through the metaphor of headwinds and tailwinds. This analogy illustrated how headwinds can impede progress, analogous to systemic barriers like lower socioeconomic origin, sexism, or racism, while tailwinds can inadvertently propel individuals forward without their active efforts. The dialogues concerning this topic elicited a spectrum of reactions. Much of the feedback underscored the emotionally charged nature of the subject. However, Survey 2 conducted by Group 1 revealed that some participants acknowledged the importance of understanding privilege within the training context.

In Survey 2, I asked, “Are there any other aspects or concepts that you would consider essential to be included in the training?” Three respondents said the conversation on privilege was the most critical. Another survey question asked respondents, “What was the single most useful aspect or concept of the training?” Twelve respondents wrote that they believed the headwinds/tailwinds conversation was the most useful concept. While these appear positive on the survey, the post-lecture small group conversations indicated that the concept of ‘privilege’ (without specifically labeling it as such) was emotion-inducing. As privilege was not a focal point of my thesis, I chose to alter the intervention content to avoid eliciting negative emotions that might distract from the primary content of advanced interpersonal skills.

I removed the small section on headwinds/tailwinds from subsequent presentations. The content change altered the intervention significantly, which invalidated Group 1 post-training data. Therefore, I removed Group 1’s Survey 2 and

Survey 3 responses from my subsequent data analysis. In this context, Group 1 served as a preliminary examination to refine the content and structure of the intervention that was subsequently deployed across the remaining groups.

5.4.3 Intervention Training Content

The restructured training intervention was delivered in a structured four-phase sequence. Initially, the issue was contextualized by quantifying pilot errors, utilizing data and reports from the Federal Aviation Administration. Subsequently, the problem was further delineated by correlating the phenomena of muted safety voice and safety silence with the existing Threat and Error Management model, concurrently highlighting a gap in the Crew Resource Management curriculum regarding interpersonal skills. The third phase involved the introduction of advanced interpersonal skills concepts. These concepts were rendered operationally relevant to flight deck procedures through the incorporation of empirical findings from prior studies and the application of theoretical narratives.

In the final phase, I presented a condensed version of my research on leadership dynamics within the aviation context. This included demonstrating a relationship between the adoption of advanced interpersonal skills and the improvement of safety outcomes, thereby substantiating the enhanced efficacy of the CRM/TEM framework. I expand on this four-part sequence in the following condensed outline in Table 5.4.3 below.

Table 5.4.3
Outline of Training Intervention

Outline		
	Broad concept	Specific concepts
Introduction	Problem Identification	Quantification of pilot error utilizing FAA material.
		Definition of *culture*
		Quantification of First Officers feeling as though they must adapt to the culture established by the Captain.
Body	Elucidating the Problem Identification	Quantification of the First Officer's participation in muted safety voice and safety silence due to a negative tone from the Captain.

		Quantification of how the perception of getting along in the microculture of the flight impacts various facets of psychological safety.
		Identification of a training gap of professional pilots on the FAA-recommend CRM interpersonal skills concepts.
	advanced interpersonal Skills	Definition and applicability of cognitive bias: how it impacts attitude and behavior.
		Definition and applicability of psychological safety: 1) how biased behaviors reduce psychological safety; 2) risk of amygdala hijack inducing tunnel vision, fatigue, and increased stress; and 3) how psychological safety can be used to generate a microculture conducive to safety voice.
		Definition and applicability of interpersonal communication: how it differs from impersonal communication, and how it can be used to increase psychological safety.
Conclusion		Shared responses from First Officers expressing how best to set the tone to develop psychological safety.
		Ways to improve interpersonal communication such as the influence of power, fundamental attribution error, naive realism, and a growth mindset.
		Correlated traits and characteristics of leadership, as defined by the FAA, with advanced interpersonal skills.
		Provided a quick reference for key takeaways from the training material.

> The pertinence of the training content to routine flight deck operations was established, endeavoring to secure participant endorsement by framing the integration of advanced interpersonal skills as an essential component of effective leadership.

5.5 Study Design - Qualitative Data Collection

The collection of qualitative data was conducted via the systematic gathering of narrative accounts via semi-structured interviews with attendees of the Standards Meeting. The transcription of these interviews facilitated an analytical process that encompassed iterative rounds of open, axial, and selective coding, thus enabling the identification of emergent patterns. Through the process of memo-writing, the data was further distilled, permitting the creation of a theoretical framework in accordance with the principles of grounded theory (Charmaz, 2006; Bryant & Charmaz, 2007).

Following the preferred lexicon of quantitative and qualitative sociologists, I refer to the pilots who completed the survey as “Respondents” and those who completed the semi-structured interview as “Informants” (Bernard & Ryan, 2010). Quantitative research aims for generalizable findings, while qualitative research offers detailed specificity. My research focuses on how behavioral nuances in the flight deck shape a psychologically safe microculture and boost aviation safety. Because surveys struggle to capture nuances compared to one-on-one discussions, I prioritize informant feedback over respondent numbers for gathering behavioral insights.

Determining the appropriate sample size was a key methodological consideration for the semi-structured interviews in this study. Although the magnitude of the sample is important, literature does not prescribe an obligatory numerical threshold; rather, it acknowledges the intrinsic value of examining even a singular, atypical instantiation of the phenomenon under investigation, as described by Sandelowski (1995). This underscores the imperative of depth over breadth within qualitative study.

This study aimed to explore a wide range of behaviors impacting psychological safety, focusing on the effects of social power dynamics like in-group affiliation versus out-group categorization with lower status. To achieve this, purposeful stratified sampling was used to ensure demographic diversity and enable a thorough analysis of social hierarchies' influence on psychological safety.

5.5.1 Semi-Structured Interview Participant Recruitment

As outlined earlier, Pilot Safety Leaders (PSLs) were given access to Survey #2 post-training via a Quick Reference (QR) code and survey hyperlink while in the conference room. The last question of the survey was:

> Would you be interested in participating in a one-hour interview with Kimberly to further discuss these topics? Interviews will be conducted on a voluntary basis,

> via Zoom, within the next 12 months. All responses are strictly confidential, will not be shared with —- [redacted for anonymity] Airlines, and will be used for research purposes only. Your participation is much appreciated. If you're interested, please leave your contact name and email address here so I can follow up. And, if you're inclined to, please feel free to share why you're interested in volunteering for a follow-up discussion. Thank you!

One hundred fifty-five (n=155) pilots volunteered to be interviewed. Given the relatively large volume of volunteers, I initially utilized probability sampling (Bernard & Ryan, 2010) in my selection of interviewees. I sent twenty-five emails selected at random reminding PSL's they had volunteered and inviting them to schedule a Zoom call. I provided dates and times for potential Zoom calls while customizing every email with their name.

Recognizing the sparse representation of non-prototype pilots, I concluded that stratified sampling (Sandelowski, 2001) would be more appropriate. Within a short timeframe, I arranged interviews with five PSLs, four of whom were prototype pilots.

Of the one-hundred fifty-five volunteers, only forty had completed Survey 1 (where the demographic data was collected). I emailed all non-prototype pilots as a priority, of which there were three (one non-male and two non-White males). To further the objective of enhancing demographic heterogeneity, an analytical review of email addresses was conducted with the intent to infer gender identity, particularly focusing on names conventionally associated with the female gender. This examination yielded six presumptive identifications of female participants, to whom correspondences were promptly dispatched to solicit their participation in the interview process.

The initial phase of electronic correspondence yielded only a modest number of immediate affirmatives for interview scheduling. Consequently, a series of follow-up emails were sent to enhance response rates. I then went back to the original list of PSLs on a renewed outreach effort, adopting a randomized approach to contacting the remaining volunteers. This process resulted in a total of 67 personalized emails being sent which resulted in the successful scheduling of twelve interviews. With these twelve participants, I proceeded to the subsequent stage of data collection, cognizant of the possibility of re-engaging with the volunteer pool should the data procured not reach a point of saturation.

Prior to conducting interviews, each interviewee received a *Before We Takeoff* checklist in PDF form that informed them of the study content, their ability to withdraw from the study at any point, and the logistics for the Zoom meeting.

5.5.2 Interview Guide and Logistics

As part of the data collection instrumentation, an interview guide was created (see Appendix D). The interview guide consisted of 15 semi-structured questions spanning the eight research questions. The interviews aimed to retrieve sufficient data to augment the previous surveys and confirmatory research questions, but they also focused on open-ended questions eliciting interviewees to reflect on concepts anew in

order to gather rich data (Charmaz, 2006). The primary focus was on the three exploratory research questions.

In alignment with best practices for qualitative research, and particularly within the grounded theory approach, it is advised that interview sessions be confined to a duration of no more than one hour, accompanied by restrained notetaking to maintain the natural flow of conversation (Levy & Hollan, 1998). Upon securing informed consent from each participant, I utilized a digital voice recording application, specifically 'Voice Memo', to audibly capture the entirety of the interview discourse. After the interview, the audio files were transmitted to a specialized transcription application, known as 'Transcribe', which facilitated the conversion of the spoken word into text, yielding a Microsoft Word document.

This transcribed data was then imported into ATLAS.ti, a qualitative data analysis software. Using this tool, I embarked on a systematic process of manual analytic coding, adhering to the grounded theory methodology (Charmaz, 2006).

5.5.3 Other Considerations for the Semi-Structured Interviews

Echo probing was utilized to encourage elaboration of answers and to confirm my understanding of the Informants' responses. Notes were collected on body language, long pauses, and emotions expressed through voice inflections or gestures (Miles & Huberman, 1994). Tags were created for any awkward pauses that indicated hardship in answering the question due to self-censoring. These notes were then included in the coding and memo process.

5.6 Analysis

The evaluation of data procured from Surveys 1 and 2 was conducted through a quantitative analytic framework to scrutinize the extent to which the Pilot Safety Leaders' (PSLs') comprehension and attitudes were shaped by the lecture-based training intervention. This analysis involved carefully comparing these findings with the data collected from Survey 3 to understand how the PSLs' understanding and perspectives may have changed over time.

In executing this comparison, a non-parametric statistical test, the Wilcoxon signed-rank test, was employed to assess differential responses across six constructs pertinent to interpersonal skills. This choice of statistical test was determined for its appropriateness for paired samples where the normal distribution of differences could not be assumed.

Furthermore, the quantitative findings were enriched with qualitative insights derived from open-ended, fill-in-the-blank responses within the surveys. These narrative inputs provided a nuanced complement to the numerical data, yielding a more comprehensive portrait of the PSLs' cognitive and affective shifts post-training.

In concert with the quantitative analysis, the semi-structured interview data was subjected to a grounded theory analysis, as conceptualized by Charmaz (2006). This process involved an initial phase of open coding, where discrete incidents were

identified and coded, followed by axial coding, which involved the relating of codes to each other, and finally, selective coding, where I integrated and refined the categories around a core category.

The analytical journey culminated with the writing of reflective memos after each interview, which served as pivotal intermediaries between the coding and the development of a substantive theory (Charmaz, 2006). These memos were instrumental in consolidating nuances within the data, identifying gaps, and directing subsequent data collection. The iterative interplay of coding and memo writing enabled the emergence of a grounded theory that was deeply rooted in the empirical evidence, thereby contributing to a rich conceptual understanding.

5.6.1 Coding

As with best practices for deductive coding, preliminary codes were established in my code book (Miles, Huberman, Saldana, 2014). While the a priori approach was well suited for the confirmatory research questions designed to augment the quantitative data analysis, an alternate approach was utilized in operationalizing the exploratory research questions.

Inductive coding was more of an iterative process as it did not start with a code book. Rounds of open coding were followed by axial coding. Axial coding relates categories and subcategories adding dimensions to a category (Strauss & Corbin, 1990; Charmaz, 2006), which was necessary to remove ambiguity and add structure.

Since axial coding encourages researchers to apply an analytic frame to the collected data (Charmaz, 2006), memo writing was an easy transition. This iterative process required that I constantly move between data, codes, and writing. As memo-writing requires tolerance of ambiguity (Charmaz, 2006), I decided it was appropriate to transition between interviewing, coding, and memo-writing then starting anew with the next group of interviewees. Some themes were made less significant as new data was collected while other themes became foundational in drafting discoveries.

5.7 Chapter Conclusion

This chapter establishes the foundation for interpreting the research findings by examining participants through quantitative surveys and qualitative interviews. It explores participant demographics, including experience levels, and outlines the mixed-method research design, emphasizing the importance of a longitudinal approach. A quick reference table highlights interpersonal skills constructs identified in surveys, aiding subsequent chapters. A taxonomy simplifies data levels and respondent counts across surveys. Detailed descriptions of the intervention structure and content, along with the iterative design process, are provided. Statistical analysis is discussed to assess bias impact on post-intervention responses. The qualitative data collection process, including sampling and analysis, is explained, paving the way for uncovering research results.

The forthcoming chapter is dedicated to unraveling and examining the outcomes pertaining to the first five research questions. Through analysis and interpretation, it

aims to shed light on the findings derived from these specific inquiries, offering deeper insights into the study's focal areas.

Chapter 6 – Results from Survey Data

6.1 Chapter Overview

The previous chapter has laid the groundwork by establishing a foundational understanding of the research methods. This chapter addresses Research Questions 1-5 utilizing the survey data. This chapter establishes Pilot Safety Leaders (PSLs) as Subject Matter Experts. It then investigates the effectiveness of the lecture-based intervention and examines how different demographic groups respond to the intervention's content before and after attending the training.

Analysis reveals the effectiveness of the training and the increase in endorsement for advanced interpersonal skills was statistically significant post-training. The chapter underscores the necessity of continuous training, as indicated by the decline in endorsement levels observed after six to nine months without training. This underscores the importance of integrating these emerging concepts into recurrent training programs, a matter to be further explored in Chapter 8.

The chapter unveils unforeseen patterns within the data, notably a small percentage of PSLs manifesting overt anger towards advanced interpersonal skills and the displaying hostility when asked about demographic details. While these emotionally charged responses are voiced by a small minority of participants, they shed light on a deeper systemic cultural issue that potentially impedes the ability to operationalize interpersonal skills.

6.2 Positioning Participants as Subject Matter Experts

Research Question 1 examined whether Pilot Safety Leaders (PSLs) recalled receiving training on FAA-recommended interpersonal skills, while Research Question 2 investigated whether they believed these skills to be important for safety.

Through Hypothesis 1 testing, it was established that the Pilot Safety Leaders (PSLs) possess a higher level of training in FAA-recommended interpersonal skills compared to other airline pilots or non-airline, professional pilots in general, thus positioning PSLs as Subject Matter Experts for CRM.

After analyzing the cognitive dimension indicating Pilot Safety Leaders (PSLs) possess extensive training, Hypothesis 2 testing focused on examining the affect dimension. By employing precise language extracted from the FAA Advisory Circular on Crew Resource Management (FAA, 2004), PSLs were queried regarding their perception of the significance of specific FAA-recommended skills in enhancing safety. Results revealed robust endorsement for all three skills, with 92% prioritizing adaptability, 97% emphasizing the importance of setting the appropriate tone, and 79% recognizing the significance of demonstrating sensitivity toward other crewmembers.

Please refer to Appendix E for comprehensive details concerning hypothesis testing, data analysis methodologies, and an extensive discourse related to Research Questions 1 and 2.

6.3 PSLs' Perceived Importance of Advanced Interpersonal Skills

Research Questions 3 and 4 aimed to evaluate the response of Pilot Safety Leaders (PSLs) to the inclusion of advanced interpersonal skills (bias literacy, psychological safety, and interpersonal communication) in CRM training. These inquiries specifically aimed to gauge PSLs' perceived importance of these concepts for safety, both prior to (RQ3) and following (RQ4) the intervention.

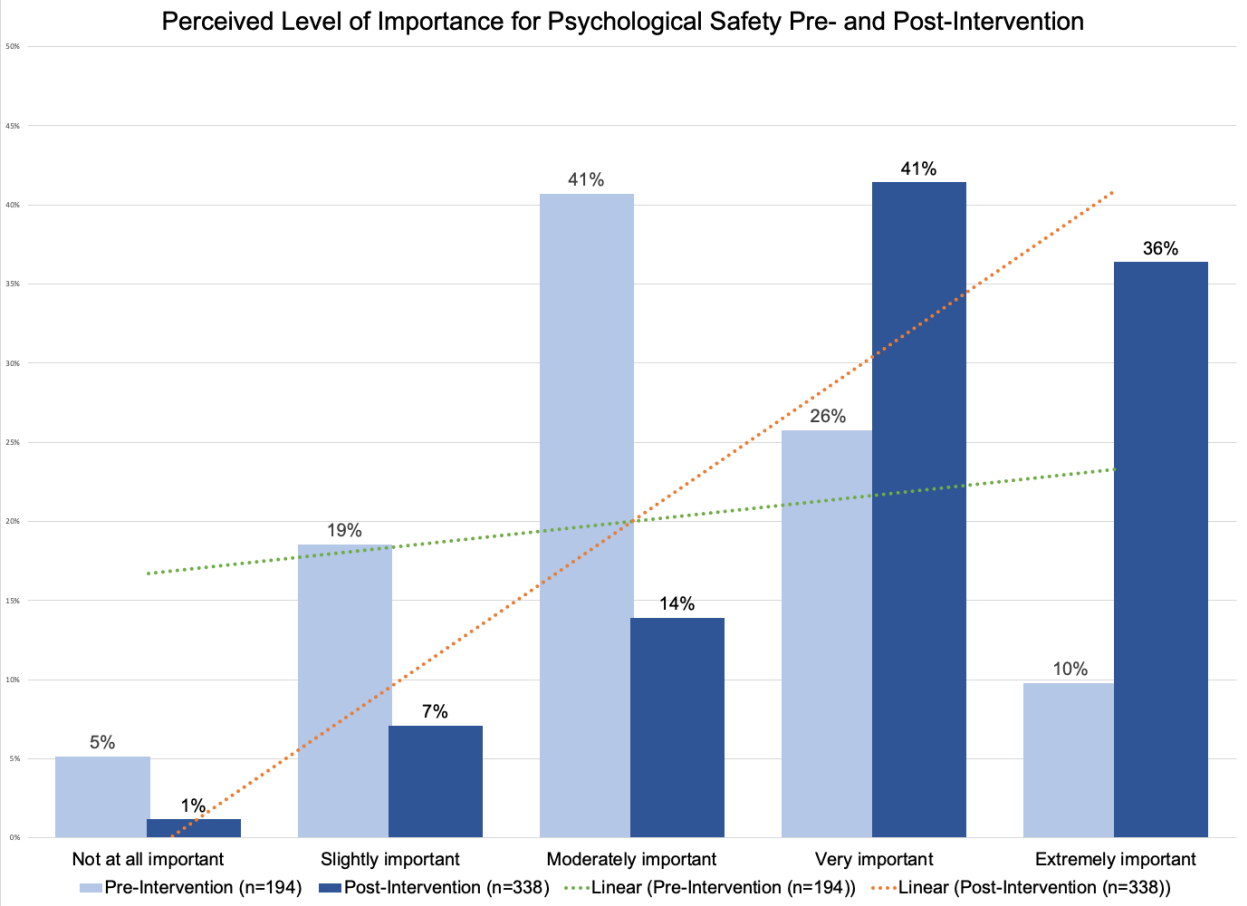
To determine if their support increased after the training, the study used three methods: statistical analysis to measure measurable changes, thematic analysis to find patterns in write-in survey data, and comparative analysis to compare responses before and after the intervention. An expanded analysis of RQ3 and 4 can be found in Appendix F.

6.3.1 Intervention Effectiveness: Statistically Significant Results

Across all three advanced interpersonal skills concepts, Pilot Safety Leaders (PSLs) demonstrated increased endorsements after training, with the concept of "psychological safety" experiencing the greatest increase. Specifically, there was a 58% increase in PSLs selecting "very important" and a 260% increase in PSLs selecting "extremely important". Figure 6.3.1.a provides a visual representation of all Likert-scaled responses pre- and post-intervention, including n values and trends. The pre-intervention linear trend line (depicted in green) indicates a relatively evenly distributed range of responses, while the post-intervention trend line (depicted in orange) illustrates a notable escalation in perceived importance across the x-axis, moving from "not at all important" to "extremely important".

Figure 6.3.1.a

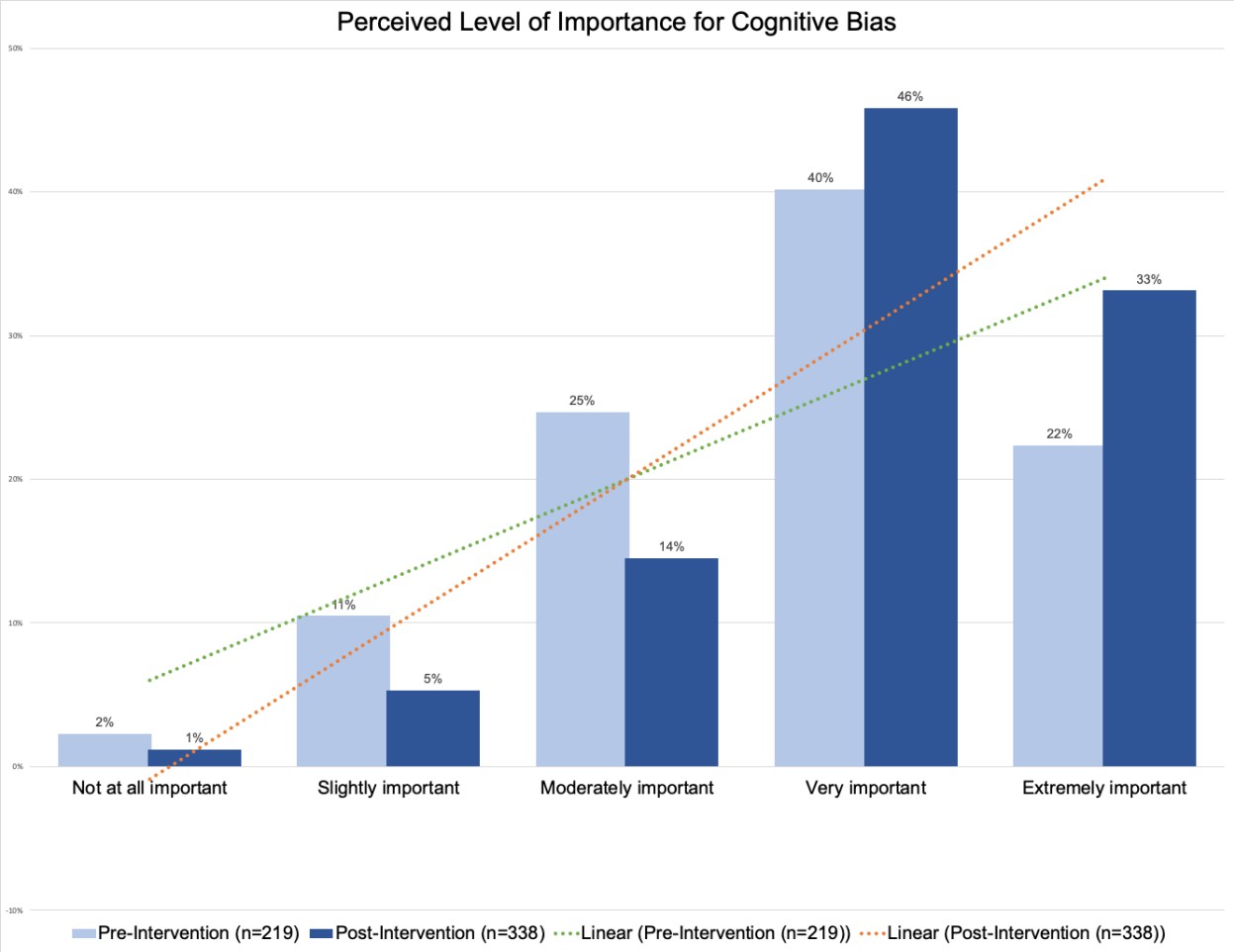
Perceived Level of Importance for Psychological Safety Pre- and Post-Intervention



There was a notable rise in endorsement for the concepts of "cognitive bias" and "interpersonal communication," albeit less pronounced compared to "psychological safety." Figure 6.3.1.b illustrates the percentage change in perceived importance for training "cognitive bias" as part of CRM, indicating a 15% increase for "very important" and a 50% increase for "extremely important."

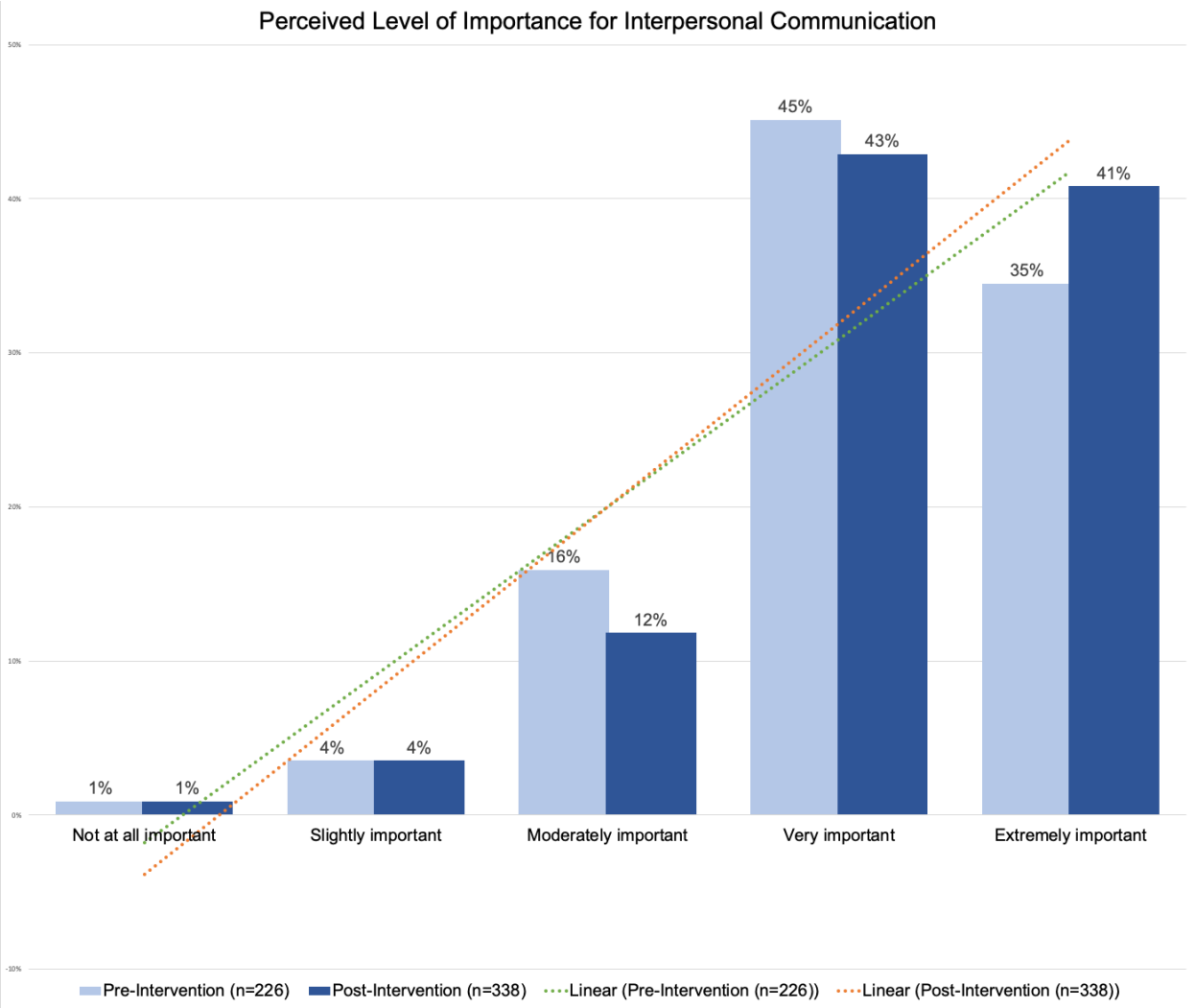
Figure 6.3.1.b

Perceived Level of Importance for Cognitive Bias Pre- and Post-Intervention



The concept of "interpersonal communication" exhibited a decrease of 4% in the "very important" category but showed an increase of 17% in the "extremely important" category, as depicted in Figure 6.3.1.c.

Figure 6.3.1.c
Perceived Level of Importance for Interpersonal Communication Pre- and Post-Intervention



The training concepts of "cognitive bias" and "interpersonal communication" initially displayed a higher perceived value compared to psychological safety, as evidenced by a more evenly distributed range of responses pre-intervention, denoted by a less steep green linear trend line.

However, there was a notable shift in responses indicating "moderately" and "very important" values from pre-intervention towards "extremely important" levels in post-intervention responses, as indicated by the upward trend of the post-intervention (orange) linear trend vector. The increased steepness of the post-intervention orange

trend line compared to the pre-intervention green line suggests that the overall level of endorsement increased after training.

To determine whether these findings were statistically significant, a Wilcoxon signed rank test was utilized for hypothesis testing. Testing for a null hypothesis that the median of the paired differences was zero, Table 6.3.1 presents the valid sample sizes, the test statistics denoted by V, and the corresponding p-values for each evaluated construct.

Table 6.3.1
Testing for Endorsement Change Post-training Intervention

Construct	Test statistics and p-values	N=
Cognitive Bias	V=1741.5, p<.001	213
Psychological Safety	V=886, p<.001	192
Interpersonal Communication	V=2888, p=.051	224
Adapt	V=6485.5, p<.001	335
Tone	V=4219.5, p<.001	335
Sensitivity	V=2553.5, p<.001	331

From the table, we can see that the p-values, representing the probability of the null hypothesis, are extremely small for all six interpersonal skills constructs. Therefore, we can reject the null hypothesis and infer from the statistics that the increase is a result of the intervention. The relatively higher p-value for interpersonal communication necessitated additional analysis, revealing that the pre-existing endorsement for this skill was already high, thereby reducing the margin for noticeable improvement. To read the full analysis, please reference Appendix F, section F.2.

In summary, after asking PSLs their perceived level of importance of the six interpersonal skills pre- and post-intervention and recording their responses, we can conclude there was a positive increase in the endorsement as a result of the intervention and that the increase was statistically significant.

6.3.2 Intervention Effectiveness: Thematic Analysis

The thematic analysis, described in detail below, reveals crucial insights into Pilot Safety Leaders' (PSLs) perceptions of a training intervention on advanced interpersonal skills. The majority of PSLs (82.2%) expressed satisfaction with the intervention training, suggesting no changes, while a small percentage displayed negative sentiments towards certain aspects, such as the training's length, complexity, or specific topics such as “power” and “demographics.”

6.3.2.1 Thematic Analysis Overview

A thematic analysis (TA) offers a method to identify patterns within and across data (Humble & Mozelius, 2022); it is not intended to generate theory - as I will do later using the grounded theory methodology (Charmaz, 2006). A hallmark of TA is its accessibility and flexibility (Clarke & Braun, 2017); therefore, I use it within this subsection to deepen understanding of PSL's endorsement of the three advanced interpersonal skills post-training intervention by analyzing their responses to two fill-in-the-blank survey questions.

Survey 2 asked all respondents the following questions:

> Question A: If any, which aspects or concepts could have been left out of the training?
>
> Question B: What was the single most useful aspect or concept of the training?

The dichotomy presented by the two survey questions is academically significant as it strategically frames the responses of Pilot Safety Leaders (PSLs) in contrasting lights and provides a comprehensive perspective on the training content. Question A, which is negatively poised, affords PSLs the latitude to express discontent or critique the training by recommending the omission of specific elements, thus identifying areas they perceive as least beneficial or redundant. Conversely, Question B, with its positive orientation, compels PSLs to affirm the value of the training by identifying and advocating for the content they deem most crucial, revealing what they consider most utilitarian or beneficial for enhancing safety.

This approach not only captures the full spectrum of PSL sentiment toward the training content—from the most to least valuable aspects—but also provides insights into the perceived applicability and relevance of the training in their professional context. The juxtaposition of negative and positive framing allows researchers to dissect the multifaceted attitudes of PSLs, enabling a more nuanced understanding of their endorsement patterns and the potential gaps or strengths within the training curriculum. This methodological design is key to driving improvements in educational interventions and tailoring content to meet expert practitioners' needs more effectively.

6.3.2.2 Concepts to be Disregarded from Training

Across Groups 2-4, Survey 2 Question A received a total of 359 responses. All data was coded through an iterative process where eleven themes emerged. Please see Table F.3 in Appendix F for the total n value for each theme, and representative examples of the theme utilizing direct quotes.

Through the lens of a thematic analysis of Question A, the vast majority (82.2%, N=295) of respondents showed a positive endorsement for the advanced interpersonal skills by responding positively toward the content by recommending no changes be made to the training. Such endorsement can be seen from the respondent's write-in responses, "This training was absolutely fantastic and I want to learn more" and "This

was all very fascinating. I love how much our industry continues to deep dive and evolve our understanding and impact of CRM to safety."

I was not able to determine the endorsement level for a small percentage (3.6%, N=13) of respondents whose responses were categorized as *other*. The remaining 14.2% (N=59) showed negativity either toward the content, but mostly the negative comments displayed disconnect in general, as opposed to specific concepts, elucidated from these write-in responses: "Today's social culture warfare in America" and "Don't burden people with your problems because you can."

6.3.2.3 The Most Useful Concept of the Training

The vast majority of respondents (95.5%, N=555) showed endorsement of the training by selecting a useful aspect of the training. In contrast, 1.9% (N=11) took the opportunity to write something negative either about a facet of the training content or something negative about me directly. Another 2.6% (N=15) wrote in responses where the intent was unclear, so determination on endorsement remains unmeasurable. It is not surprising that Question B received a higher level of endorsement as the question was positioned in the positive, suggesting the training contained inherent utility.

A more comprehensive list of write-in responses to this survey question can be found in Appendix F.

6.3.3 Intervention Effectiveness: Comparative Analysis of Sentiment

Before the intervention, only 23.3% of Pilot Safety Leaders (PSLs) exhibited a positive sentiment toward advanced interpersonal skills, but following the training, this figure increased dramatically to 82.2%, as evidenced in Table F.4 of Appendix F. This represents a substantial percentage change, with a notable surge of 252.8% in positive sentiment post-training. Additionally, there was a slight decrease of 15.5% in negative sentiment. For an in-depth comparative analysis, encompassing the sentiment coding methodology and the content analyzed, readers are encouraged to refer to Appendix F, section F.4.

6.3.4 Summary of Intervention Effectiveness

In addressing Research Question 4, a combination of statistical, thematic, and sentiment analyses was employed to assess the impact of a lecture-based intervention on Pilot Safety Leaders' (PSLs) endorsement of advanced interpersonal skills, confirming Hypothesis 4. The distinction between cognitive understanding and attitudinal endorsement of these skills emerged as pivotal in evaluating the intervention's effectiveness. The hypothesis anticipated a positive change post-intervention, expecting an increased endorsement from pilots. Statistical analysis using the Wilcoxon signed-rank test yielded low p-values, rejecting the null hypothesis, and indicating a significant positive shift in endorsement. Thematically, the analysis unveiled overwhelmingly positive feedback from respondents, with many recommending no alterations to the training content. This qualitative dimension complemented the quantitative findings. Additionally, sentiment analysis revealed a notable surge in

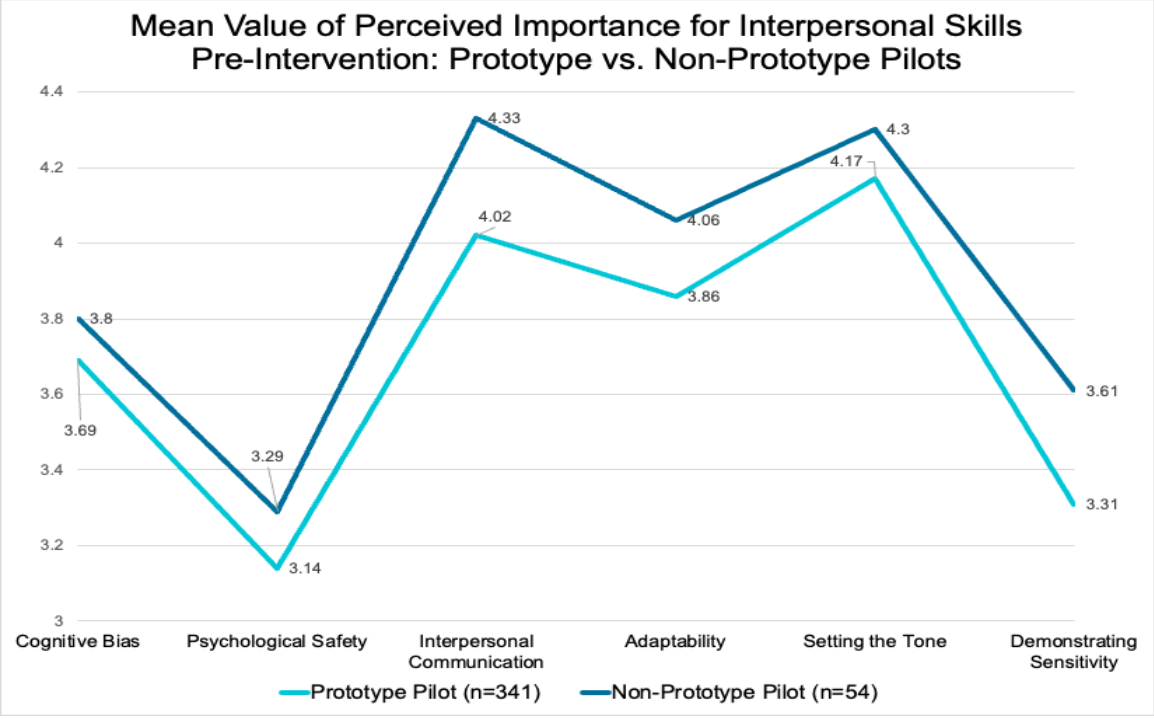
positive sentiment towards interpersonal skills post-intervention, indicative of a substantial shift in PSLs' attitudes prompted by the training.

6.4 Non-Prototype Pilots Have a Higher Level of Endorsement for Advanced Interpersonal Skills

Research question 5 and hypothesis 4 aimed to understand whether non-prototype pilots felt interpersonal skills were important for safety in the flight deck prior to the intervention. That is to say, could being a part of a marginalized group status predict the level of endorsement for training pilots on interpersonal skills prior to any interventions? I hypothesized that it could, which the data confirmed.

Using mean values from both prototype and non-prototype pilots concerning their perceived importance across the six interpersonal skills concepts (three established by the FAA and three advanced) prior to an intervention (referred to as Time 1 or "T1"), Figure 6.4 illustrates that non-prototype pilots (depicted as dark blue) displayed a higher perceived value than non-prototype pilots (depicted as teal).

Figure 6.4
Mean Value of Perceived Importance for Interpersonal Skills Pre-Intervention: Prototype vs. Non-Prototype Pilots at Time 1(T1)



An identical analysis was conducted, stratifying the respondents into three distinct demographic cohorts: White men, non-White men, and women and non-binary

individuals. Comprehensive findings of this analysis, accompanied by a detailed elaboration of the data collection methodology and analytical approach, are presented in Appendix F, section F.5.

6.4.1 Perceived CRM Value of Demonstrating Sensitivity - A Comparative Analysis of Prototype and Non-Prototype Pilots

Another framework we can use to answer Research Question 5 is to determine the baseline appreciation for the link between demonstrating sensitivity and Crew Resource Management skills. In Survey 1, respondents were asked a binary question (yes/no choice): “When being evaluated on CRM skills, must you demonstrate your understanding of the usefulness of showing sensitivity to other crew members’ personalities and styles?” This question comes directly from FAA AC 120-51E (see b. (2), p. 11). The responses are documented in the following table.

Table 6.4.1
Demonstrating Sensitivity as part of CRM; Analyzed Across Demographics

Survey Response	Women		Non-white Men		White Men	
	N value	Percentage	N value	Percentage	N value	Percentage
Yes	20	83.3%	36	83.7%	255	66.6%
No	4	16.67%	7	16.3%	128	33.4%

A Fisher’s exact test (based on permutation) was performed on women versus White men and non-White men versus White men. The p-values are 0.1154 and 0.0240 respectively. Although we should not over-interpret p-values, the summary statistics in the table and p-values reflect that there might exist a difference in this question between the groups we are testing.

As Table 6.4.1 indicates, 83% of women and non-White men understand the link between sensitivity and CRM prior to the intervention whereas only 67% of White men share that understanding. While this test alone is not the complete picture, it provides insight that women and non-White men (e.g., non-prototype pilots) may have a higher level of endorsement for interpersonal skills than White men (e.g., prototype pilots) prior to the intervention.

6.4.2 Non-Prototype Pilots Find Higher Value of Interpersonal Skills than Prototype Pilots Regardless of Intervention

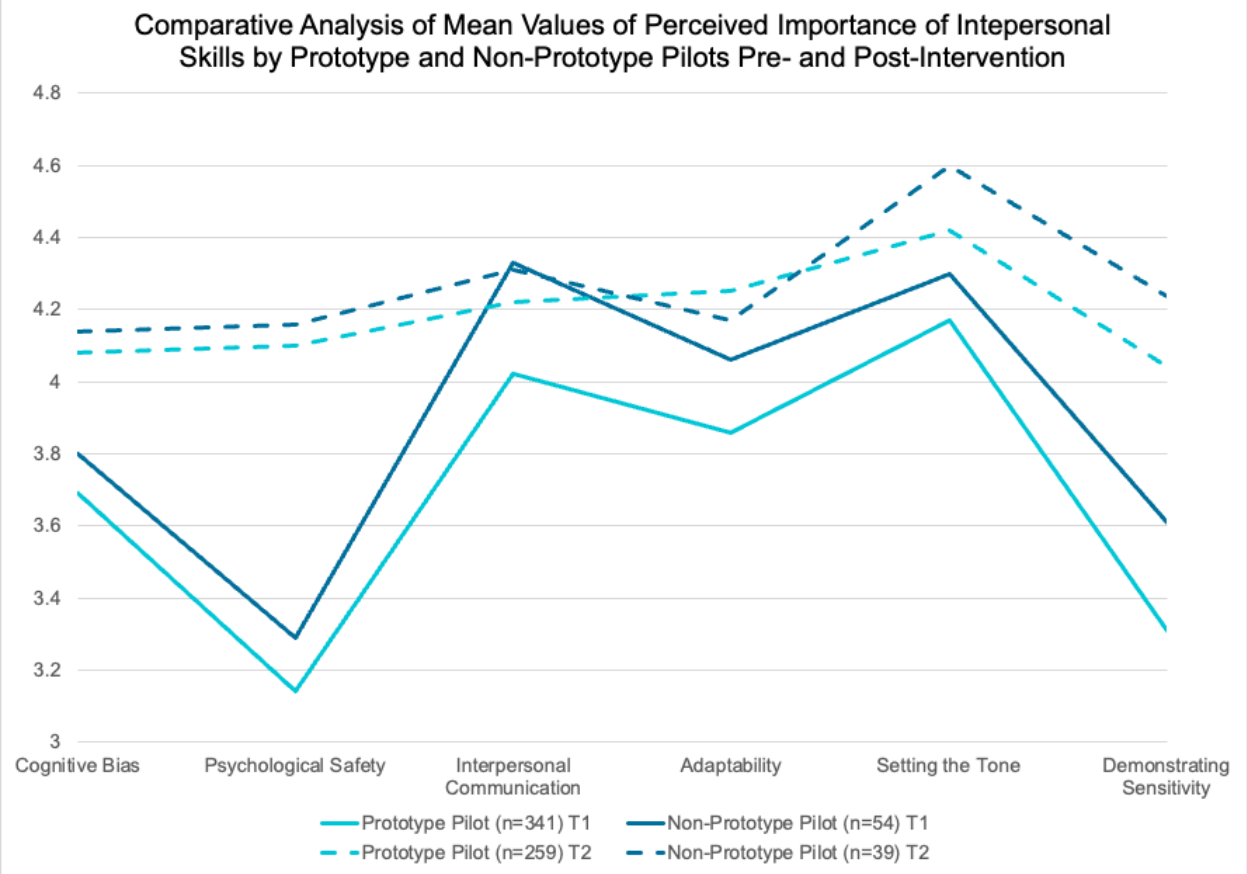
Across all measured interpersonal skills, including both FAA-recommended and advanced concepts, non-prototype pilots exhibited a higher level of endorsement before the intervention. This trend persists post-intervention, except for the skill "adaptability," where both non-prototype and prototype pilots showed similar mean values. Table 6.4.2

presents the pre- and post-intervention mean values for both prototype and non-prototype pilots. Furthermore, Figure 6.4.2 provides a visual representation of this trend, indicating that non-prototype pilots consistently attribute a higher level of significance to interpersonal skills both before and after training. This suggests that irrespective of the intervention, non-prototype pilots perceive interpersonal skills as more important for enhancing safety than prototype pilots.

Table 6.4.2
Mean Values of Perceived Importance of Interpersonal Skills at T1 and T2 for Prototype and Non-Prototype Pilots

Interpersonal Skill	Pre-Intervention (T1)		Post-Intervention (T2)	
	Prototype Pilot (n=341)	Non-Prototype Pilot (n=54)	Prototype Pilot (n=259)	Non-Prototype Pilot (n=39)
Cognitive Bias	3.69	3.8	4.08	4.14
Psychological Safety	3.14	3.29	4.1	4.16
Interpersonal Communication	4.02	4.33	4.22	4.31
Adaptability	3.86	4.06	4.25	4.169
Setting the Tone	4.17	4.3	4.42	4.6
Demonstrating Sensitivity	3.31	3.61	4.04	4.236

Figure 6.4.2
Mean Values of Perceived Importance of Interpersonal Skills at T1 and T2 for Prototype and Non-Prototype Pilots

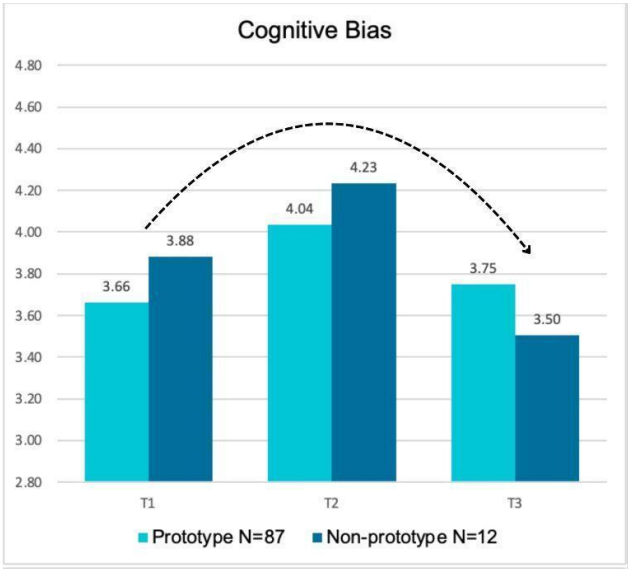


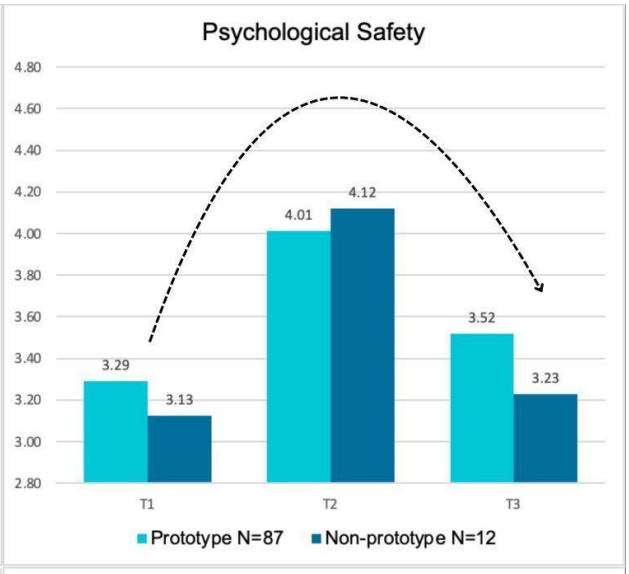
Please see Appendix F, section F.5.1.1 for an expanded analysis.

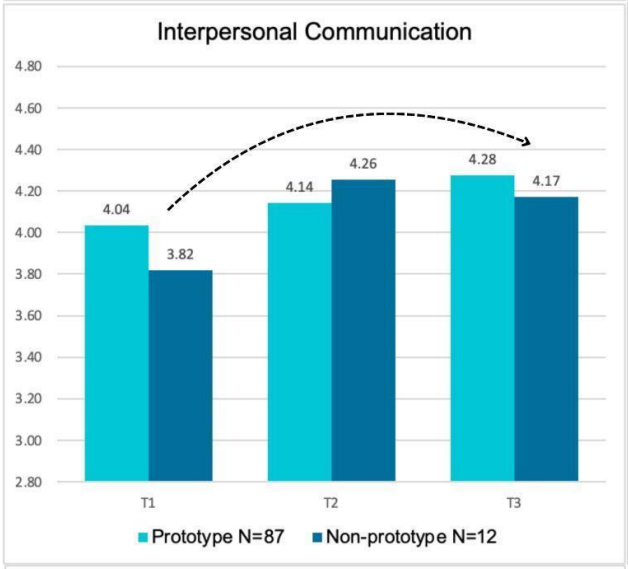
6.4.2.1 Longitudinal Analysis

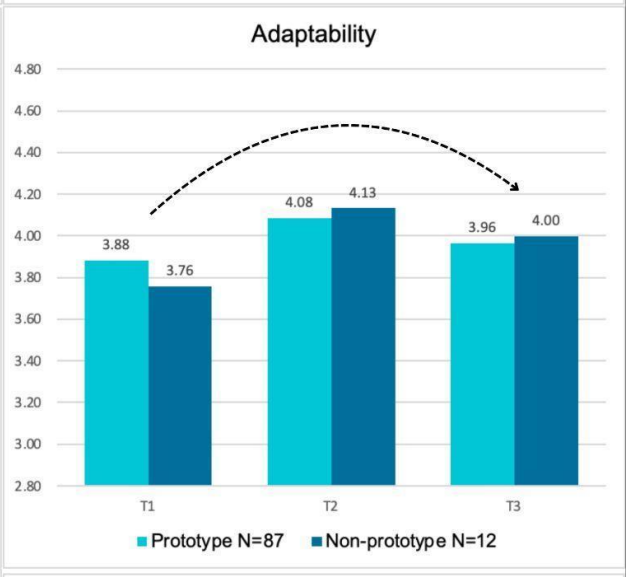
Continuing the longitudinal analysis, the study proceeded to examine Survey 3 responses collected at Time 3 (T3), six to nine months post-intervention, which included 87 Prototype Pilots and 12 Non-Prototype Pilots. Figure 6.4.2.1 shows an initial favorable reception to interpersonal skills training among both non-prototype and prototype pilots. However, a temporal analysis indicates a decrease in this endorsement as the period extends from the second to the third survey timepoint. This trend underscores the ephemeral nature of the training's efficacy and signals the need for periodic reinforcement of the skills acquired.

Figure 6.4.2.1
Longitudinal analysis of Mean Values for Endorsement for Interpersonal Skills at T1, T2, and T3 for Prototype and Non-Prototype Pilots


Cognitive Bias
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
3.66
3.88
4.04
4.23
3.75
3.50
T1
T2
T3
Prototype N=87
Non-prototype N=12


Psychological Safety
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
3.29
3.13
4.01
4.12
3.52
3.23
T1
T2
T3
Prototype N=87
Non-prototype N=12


Interpersonal Communication
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
4.04
3.82
4.14
4.26
4.28
4.17
T1
T2
T3
Prototype N=87
Non-prototype N=12


Adaptability
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4.60
4.40
4.20
4.00
3.80
3.60
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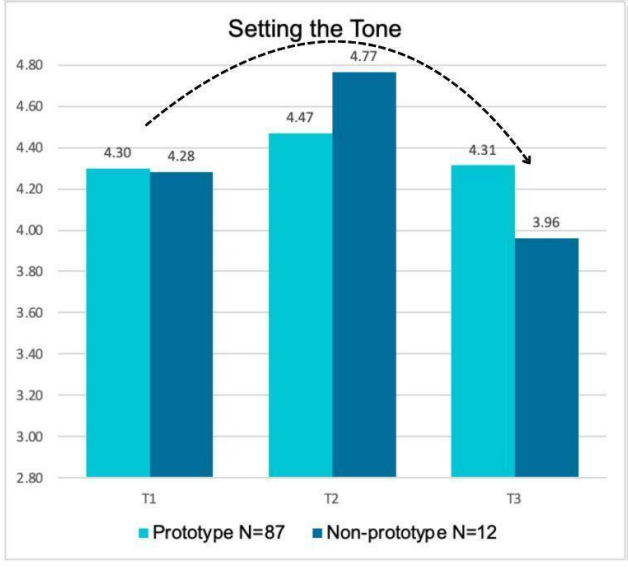
3.20
3.00
2.80
3.88
3.76
4.08
4.13
3.96
4.00
T1
T2
T3
Prototype N=87
Non-prototype N=12


Setting the Tone
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4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
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4.30
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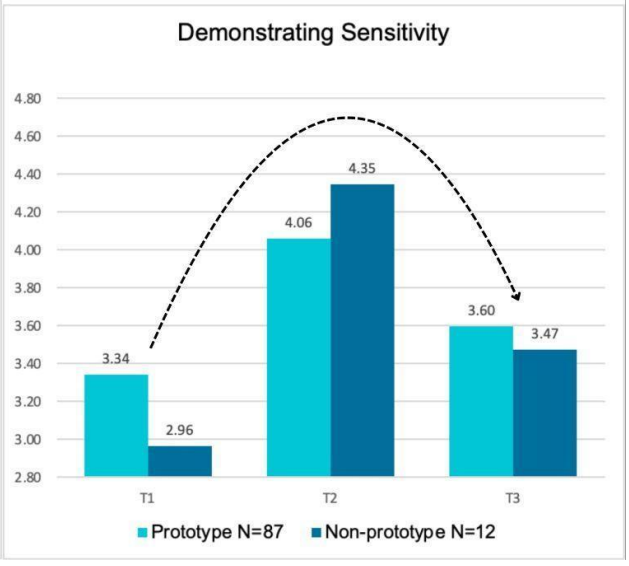
4.47
4.77
4.31
3.96
T1
T2
T3
Prototype N=87
Non-prototype N=12


Demonstrating Sensitivity
4.80
4.60
4.40
4.20
4.00
3.80
3.60
3.40
3.20
3.00
2.80
3.34
2.96
4.06
4.35
3.60
3.47
T1
T2
T3
Prototype N=87
Non-prototype N=12

For an in-depth analysis of the methodology and expanded tables for the longitudinal analysis across demographic variables, please see Appendix F, section F.5.

6.4.3 Summary of Perceived Importance of Interpersonal Skills between Prototype and Non-Prototype Pilots

Quantitative statistical analysis was employed to assess mean levels of endorsement for interpersonal skills training for prototype and non-prototype pilots. Results indicated that prior to the intervention, prototype pilots (White men) demonstrated the lowest level of endorsement compared to non-prototype pilots (non-White men, women, and non-binary individuals). Longitudinal analysis of survey data collected at two post-intervention time points—immediately following the training ("T2" and again at a 6–9-month interval ("T3")—revealed that while all demographic groups acknowledged the intervention's value, non-prototype pilots generally exhibited a higher level of endorsement for interpersonal skills. Furthermore, the analysis unveiled a decline in endorsement for all demographic groups after six to nine months post-training.

Collectively, these vignettes of research along with the hypothesis testing confirm H4 and answer our research question in the affirmative substantiating that belonging to a marginalized group is predictive of perceiving heightened importance for flight deck advanced interpersonal skills training.

Up to this point, the dissertation has primarily concentrated on addressing the defined research questions. Nonetheless, noteworthy themes have surfaced from the gathered information that merit attention. The data unveiled a certain degree of resentment towards concepts related to interpersonal skills and discomfort when respondents were queried about their demographics. These observations hold significance for a more expansive discourse on aviation culture and offer insights into potential obstacles to improving CRM training. Furthermore, they furnish context for why this advanced training should be contextualized within the framework of a sociotechnical system, rather than merely focusing on bias training. The inadvertent repercussions of querying PSLs about advanced interpersonal skills and race/gender demographics are documented in the subsequent section. Their significance in the wider context is deliberated upon in Chapter 8.

6.5 Perceptions of Interpersonal Skills as a Political Agenda and Latent Anger Among Respondents

One survey question examined the perspectives of Pilot Safety Leaders (PSLs) through a write-in response method regarding the relevance of advanced interpersonal concepts, going beyond descriptive statistics to analyze qualitative responses. Through the analysis of 304 write-in responses, it becomes evident that a subset of PSLs acknowledges the importance of concepts such as cognitive biases, psychological safety, and interpersonal communication in improving safety. For instance, one respondent highlights how cognitive biases can affect decision-making, while another

emphasizes the role of interpersonal communication in facilitating crew coordination. These responses validate the research goal of integrating these concepts into future Crew Resource Management (CRM) training.

Ten percent of responses, a small but notable proportion, exhibited negative sentiment, criticizing aspects such as the company's training program or expressing skepticism towards concepts like psychological safety, often associating them with political agendas or perceived emotional fragility of millennials, calling them “woke” as a method to devalue or delegitimize their importance. These sentiments are displayed in the following comments:

1. “Psych safety sounds too broad and sounds like code for CRT [Critical Race Theory] ideas which I reject as destructive.”
2. “Today’s new hire pilots demonstrate poor work ethic, inability to focus, lack of dedication, and a shortfall of general professionalism.”
3. “The millennials and younger just need to do their jobs. Speak up when you don't see SOP, otherwise, sit there and be a good FO.”
4. “Don’t hire snowflakes.”
5. “I think it is mostly a woke term used to push social agenda versus improving flight safety.”
6. “Woke agendas have no place in an aviation safety environment.”
7. Psychological safety is an ill-defined term. But it reeks of ‘trigger warnings’ and ‘safe spaces’ and woke nonsense.”
8. “Everything is getting to[o] touchy-feely.”

These responses emphasize the necessity of educating pilots on sociotechnical systems to elevate the significance of interpersonal skills to a level commensurate with stick-and-rudder skills. Interpersonal competencies are perceived as diminished, often labeled as "woke," "soft," or "touchy-feely." To mitigate this perception, it is imperative to educate individuals on the interdependent relationship between human-to-human interaction and technological operation. This educational approach ensures that pilots appreciate the essential connection between interpersonal skills and effective aircraft operation, thus addressing concerns about the devaluation of such skills.

Additional quotes and further analysis regarding the latent anger exhibited by certain respondents towards interpersonal skills can be found in Appendix F, section F.6.

The examination of Pilot Safety Leaders' responses reveals a critical divide: while some recognize the value of concepts like cognitive biases and interpersonal communication in enhancing safety, others express skepticism, associating such concepts with political agendas or generational traits. These contrasting perspectives underscore the importance of integrating sociotechnical systems education to elevate the status of interpersonal skills alongside technical proficiency. By addressing these perceptions, aviation safety training can foster a culture where the interplay between human interaction and technological operation is valued. This analysis also sheds light on broader societal tensions surrounding diversity and inclusion, highlighting the need to address cultural narratives within safety interventions to promote inclusivity

effectively. In addition to interpersonal skills, querying Pilot Safety Leaders about their race and gender also evoked unexpected emotions from some individuals, as identified in the following subsection.

6.5.1 Uncomfortable Reactions to Inquiries on Race and Gender

Demographic survey questions provided insights into the composition of PSLs, revealing a predominance of highly experienced, male, and White pilots. The survey aimed to understand attitudes towards demographic queries, uncovering a subset of emotionally charged responses, particularly from White male respondents, expressing discomfort or objection to questions about race and gender. The demographic questions regarding race and gender offered predefined options as well as a fill-in-the-blank option. There were 72 fill-in-the-blank responses originating from 48 distinct individuals, constituting 8.1% of the entire Pilot Safety Leader (PSL) cohort that participated in the demographic questions of Survey 1.

These 72 responses contained sarcasm, such as “Earthling,” “Human” and “Batman,” as well as anger and aggression, such as “I was born with a penis, I’m a MALE!” and “This is a STUPID question.” On a few occasions, the sentiment was unclear, and the response intent cannot be gleaned without more data. In these situations, write-in responses may have been meant to be comical or interesting, but genuine intent cannot be surmised, as seen with the following examples for gender, “Chicken Dog Hamster” and “I stand up when I pee”. Similar responses were collected for the race question, such as “I look in the mirror and see the color of my skin. I’m definitely white” and “If you’re it 1st, you’re last”.

Some emotional responses showed indications of gaslighting or microaggressions in the form of ‘colorblindness’, as seen in the following examples in the table below.

Table 6.5.2.1.a.
Write-in Responses Displaying Contempt, Aggression, or Gaslighting

Gender question	Race question
“There are two genders”	“Another decisive BS question. We are all humans. Want race to stop being an issue?.. stop making it one!!!”
“How did this become a choice?”	“Human race”
“This question is BS. You are either a man or a woman. Saying you identify as something other than what you are is exactly the same as saying ‘I’m pretending to be…’”	“Woke BS”
“Reject premise of [the] question”	“What the heck is latinX???????”

“Based on the biological truth of science with the required chromosomes of a male”	“I see myself as part of the human race”

The emotional tone of these entries, coupled with their content, underscores a complex undercurrent and sentiment regarding demographic categorization and self-identification within the PSL group. The data indicates that a number of emotionally charged reactions were not only directed at the demographic questions but also at the overarching integrity of the research. Certain Pilot Safety Leaders (PSLs) perceived the solicitation of demographic data as undermining the legitimacy of the survey, and consequently, the importance of the research topic itself. This sentiment, as cataloged in the responses of Table 6.5.2.1.b, suggests that the inclusion of demographic queries may have elicited concerns among some PSLs about the motivations underpinning the study, potentially precipitating a defensive posture towards the research objectives.

Table 6.5.2.1.b.
Write-in Responses Indicating Dislike and Threatening to Devalue the Research

Gender question	Race question
“This is irrelevant to cockpit safety”	“Stupid and unnecessary question. The airplane and gravity do not care how anyone identifies. You’re losing me.”
“This has nothing to do with CRM or flight safety”	“Colorblind…the next question is ridiculous & lends zero credibility to this questionnaire.”
“This is irrelevant to cockpit safety”	“This has nothing to do with flight safety or CRM”
“This is an absurd question. Completely irrelevant!”	“Another completely irrelevant question!”
“Do not understand how this matters.”	“Why does this matt[er]”

While 8.1% does not comprise a majority, PSL’s overt anger at being asked about their race and gender warrants further exploration. Of the 48 unique individuals who wrote in illegitimate responses, 18.8% (N=9) also selected male. Of those nine, seven selected White. There were no entries of self-reporting as a woman or non-binary who also wrote an illegitimate response. Upon initial analysis, the emotionally charged responses elicited by the demographic inquiries within the survey seem to originate exclusively from individuals who self-identified as White and male. This observation suggests a particular pattern of discomfort or objection within this demographic subset in relation to questions about race and gender. It is important to note that this preliminary assessment is based on the available data, which indicates that the respondents providing such reactions have chosen to identify as both male and White. Further in-depth analysis will be necessary to comprehensively understand the

underlying factors that contribute to this specific demographic's response to the survey's demographic questions. This data is relevant within this study as these responses may reflect broader tensions surrounding the intersection of identity and professional pilots, a concept discussed further in Chapter 8.

6.6 Chapter Conclusion.

This chapter addressed Research Questions 1 and 2 by examining Pilot Safety Leaders' (PSLs) training in FAA-recommended interpersonal skills and their perception of these skills' importance for safety. Hypothesis 1 testing demonstrated that PSLs possess a higher level of training in these skills compared to other pilots, positioning them as Subject Matter Experts for Crew Resource Management (CRM). Hypothesis 2 testing revealed robust endorsement for specific FAA-recommended skills among PSLs, indicating their recognition of the importance of adaptability, setting the appropriate tone, and demonstrating sensitivity toward other crewmembers. Moving forward, Research Questions 3 and 4 evaluated PSLs' response to advanced interpersonal skills training, focusing on their perceived importance both pre- and post-intervention. Statistical analysis, thematic analysis, and sentiment analysis were utilized to assess intervention effectiveness. Results showed a significant increase in endorsement for advanced interpersonal skills post-training, confirming the effectiveness of the intervention. These findings underscore the importance of addressing both cognitive understanding and attitudinal endorsement of new training content.

The chapter also answered Research Question 5, which examines the perceived importance of interpersonal skills training among prototype and non-prototype pilots through quantitative statistical analysis. Results revealed that prior to the intervention, prototype pilots (White men) displayed lower levels of endorsement compared to non-prototype pilots (non-White men, women, and non-binary individuals). Longitudinal analysis of post-intervention survey data collected at two-time points indicated that while all demographic groups acknowledged the value of the intervention, non-prototype pilots generally exhibited higher levels of endorsement for interpersonal skills. However, endorsement levels declined for all groups after six to nine months post-training. These findings confirm the hypothesis and affirm that belonging to a marginalized group predicts a heightened perception of the importance of flight deck interpersonal skills training. Additionally, the study uncovered some sentiments of resentment towards interpersonal skills concepts and discomfort regarding demographic inquiries, offering insights into aviation culture and potential barriers to CRM training improvement.

Chapter 7 will present the results of the qualitative data collected through interviews, and Chapter 8 will then analyze the combined significance of the findings from Chapters 6 and 7.

Chapter 7 - Results from Semi-Structured Interviews

7.1 Chapter Overview

In this chapter, I answer the three exploratory research questions utilizing grounded theory as our analytical tool. Drawing from semi-structured interviews conducted between May and June of 2023, I explore the complexities surrounding psychological safety within the flight deck environment. Research Question 6 (RQ6) investigates the dynamics between Captains and First Officers, revealing three themes from thirteen insightful interviews. The first theme uncovers the influence of Captains on flight deck microculture, leading to reduced psychological safety termed the "Safety Voice Reduction Sequence". For Research Question 7 (RQ7), I examine flight deck behaviors contributing to psychological safety. Semi-structured interviews unearth three core data-driven behaviors to create psychological safety in the flight deck: setting the tone, inclusivity, and finding commonality.

Research Question 8 (RQ8) explores the impact of resilience on psychological safety, particularly regarding social issues like racism and sexism. The narratives emphasize resilience as crucial in addressing societal biases within the flight deck. They also highlight the need for further research into how generational expectations and biases influence Crew Resource Management (CRM) and Threat and Error Management (TEM). These insights contribute to a deeper understanding of how human performance shapes flight deck microcultures, and how that, in turn, impacts the ability to effectively manage risk.

7.2 Flight Deck Dynamics: Captains' Leadership and First Officers' Responses

To address this research question, I asked interviewees to share their stories of experiencing low psychological safety while in the flight deck. I then asked whether these instances occurred while they were serving as a Captain or First Officer. I noted their position of power, both social (as a member of the demographic majority or not) and institutional (Captain vs. First Officer). Within this specific research question, I share data on the interviewees' institutional power while withholding identifiable data about their social power status.

The inquiry took an exploratory approach and did not require the formulation of a hypothesis. Data-driven coding ensued through an iterative methodology, consonant with the principles of grounded theory, employing theoretical sampling to expand the breadth and depth of the codes, thereby facilitating theory construction as per Bryant and Charmaz (2007).

Following the completion of thirteen interviews, a state of data saturation was recognized. This led to the identification of three salient themes:

1. The leadership style of Captains can detrimentally impact the socio-dynamic environment of the flight deck, specifically through over management (denoted as 'micromanage') or unilateral decision-making (referred to as "siloing'').

2. Subsequently, First Officers often feel compelled to assimilate to the prevailing microculture instituted by the Captain (identified as the “chameleon effect”), an adjustment that precipitates a diminution in psychological safety.
3. This compromised state of psychological safety is manifested by First Officers through a minimization of their work engagement to essential tasks only (coded as 'bare minimum') and a withdrawal from participatory interpersonal communication.

Table 7.2 provides a definition of each of these data-driven codes and offers direct quotes from the interviewees as an example of the code.

Table 7.2
Data-Driven Codes, Definitions, and Examples

Code	Description	Example(s)
Micromanaging	Excessive recommendations on how to operate in one’s job, such as how to fly the aircraft, program the Flight Management Computer, etc. When this is done from a position of power (from the Captain), these ‘recommendations’ feel compulsory.	“They don't feel comfortable letting you fly your way. They need it to be done their way because that's how they know they can react or that's how they know they can deal with something if it goes wrong. I think it's a control and a lack of confidence. I think it's usually weaker captains that try to micromanage.” “the most annoying thing I think for most pilots is if the other pilot's trying to micromanage 'em. So obviously an FO will never try to micromanage a captain, so it's a captain issue.” “The one thing that gets me is being micromanaged. Uh, I'm okay with a suggestion, ‘Hey, I think you should do this because mm-hmm,’ but if it's just constantly, ‘I would use this, I would do that’. Then that’s not trying to show me a better way of doing something, it's just saying that they want me to do it their way of doing something. Um, so yeah, that's my trigger. That's when I would shut down.”

Siloed	A pilot (often the Captain) unilaterally making and acting on a decision that is normally team-derived and/or team-discussed. For example, stating a new plan to Air Traffic Control without input from the other pilot(s).	“I mean, the thing the actual cut [sic] CRM was when he made this decision unilaterally without talking to me about what we were gonna [going to] do. And once he'd made this decision and broadcasted, it wasn't something that we could change. He'd committed us to something without getting my input at all. So I wasn't happy about it. And I thought he was wrong too, so that didn't help.”
Chameleon effect	A condition where individuals (usually those with less relative power, such as First Officers) feel compelled to adapt to the tone, mannerisms, and microculture established by the Captain.	“absent that type of strong personality, I think it's kind of like the captain that runs the show. The captain, he or she, sets the tone.
Bare minimum	A pilot will follow SOPs, do the checklist, respond to any commands (e.g., flaps down/gear up) but will not engage in, reciprocate, or originate interpersonal communication.	“We're not gonna, we're not gonna talk get to know each other at all. We're just, it's just gonna be about work from here on out. I'm just gonna do my checklist and I'm gonna sit over here in my seat and I'm really not going to be, you almost sort of disengage. You're just kinda like, okay, we're not, we're not doing this together anymore. Mm-hmm. <affirmative>, I'm just going to sit here quietly, shut up.” “there's no, none of that kind of teamwork at the end. It's just like, all right, let's just do the minimum to shut down the aircraft, fill out the forms, and then go our separate ways.”

The following excerpts from the interviews provide more context to these data-driven codes and help bridge the gap between 1) a Captain’s action, 2) the resultant impact on psychological safety, and 3) how the reduction of psychological safety is manifested by the First Officer.

7.2.1 Story 1: Suck it Up - The Chameleon Effect

A pilot explained their experience of being micromanaged by the Captain. This pilot was a First Officer (FO) at the time. On this particular flight, the FO was also the pilot flying (PF). While in cruise, the Captain switched the required navigation performance sensitivity to a more sensitive setting than traditionally used in cruise flight. This higher sensitivity caused the First Officer to be required to make constant corrections in order to stay on course. It increased workload, which increased fatigue.

I asked whether this was part of the company's procedures. It was not. I asked why the Captain would increase workload arbitrarily. The interviewee's response was, "I don't know if machismo is the right word to put in there, but I'll use that."

Their quote continues to explain the power Captains have in building or destroying psychological safety.

> While I was hand flying and leveling out, I'm like, kind of, you know, snaking through my course, and you know, what I'm used to be, my normal course corrections for that plane were really off. It was disorienting — like, what am I doing? You know? And, um, and he snaps at me and he was like, uh, you know, I do this purposely to, you know, kind of test my First Officers.

It is worth noting that this particular experience came from a time when the pilot was at a previous airline; not from the airline where most of this dissertation data was collected.

This interviewee elaborated that this occurrence was frustrating due to the lack of communication, as opposed to the surplus of *machismo.* The FO experienced low psychological safety because of a siloed decision (to increase sensitivity in the navigation). If a crew deviates from standard operating procedures (SOPs), it should be discussed. This siloed decision caused psychological safety to diminish.

I wanted to understand how they felt about the deterioration of psychological safety, so I asked how they responded. The interviewee, acting like they were talking to the Captain, said: "you're the captain. I am gonna [sic] go along with however you want me to fly this plane, if you want me to fly it in 0.3 [increased sensitivity], so be it." This phenomenon evidences an obligatory aspect inherent in the chameleon effect, where adaptation is not so much chosen as it is imposed by situational pressures. The FO had a feeling of being required to suck it up to fit the mold established by the Captain. Ultimately, the FO felt compelled to continue with the non-standard procedure because the Captain has final authority.

The interviewee explained that their initial reaction was to roll their eyes, indicating their frustration. They elaborated as follows, "Now, my mistake in that was that I rolled my eyes at him. I completely dismissed him at that point because it was ridiculous, you know? And as much as he was playing whatever game he was playing with me, I shut him down." In hopes of re-opening the lines of communication, the interviewee said [still acting as though talking to the Captain], "you need to communicate that to me. And, um, you know, I'll do mostly whatever you want as long as we're not going to crash a plane, but you have to tell me what you're doing."

The interviewee, in a position of a relatively less power as an FO, felt compelled to adapt to the Captain's style of flying even when deviating from standard operating procedures. This story provides one insight into how the First Officers feel as though they must adapt, adopt, and adjust - that is, be a chameleon to fit into the microculture established by the Captain.

7.2.2 Story 2: Micromanaging: "It's a Captain problem"

Another interviewee shared a story from their experience of being a simulator instructor. They were in the simulator with a new hire First Officer and a pilot going through a Captain upgrade. There was a disagreement on the altitude to set for the missed approach.

Standard operating procedures require the pilot monitoring (PM) to set the altitude selector. The interviewee explained, "So they were having this discussion on what altitude to set for the initial missed approach procedure. And, you know, the guy going through the upgrade, the Captain, was saying, 'Hey, it's 3000 on the go', and the new hire FO was like, 'nah, I think it's 5,000' - [The interviewee displays a surprised look and continues] - and it was like, 'whoa - he actually just spoke up and now we're going to potentially have conflict right here."

The interview data revealed a marked astonishment from the interviewee upon the First Officer's initiative in voicing concerns, a reaction that warrants attention. This expression of surprise is notable as it contrasts with the principles of Crew Resource Management (CRM) and Threat and Error Management (TEM), frameworks where such assertiveness is not only encouraged but required. The instructor's reaction in the simulator underscores the infrequency of this assertive behavior, indicating that, particularly among newly recruited pilots, the act of articulating concerns to Captains is an uncommon practice despite it being required by CRM/TEM.

The story continues in the following:

> And the Captain was like, 'no, it's 3000' and shut down the communication. [The Captain] was the pilot flying and actually reached up and set 3000 in the altitude window. Big SOP [Standard Operating Procedure] no. And he was incorrect. The FO was right. It was a really interesting scenario. We don't see it a ton, right? I was [like], man, you guys are procedurally, you're really, really, really sharp. But from a CRM standpoint, you guys need to work on this. This is bad.

Two interesting points emerge from this story. The first is the surprise from the interviewee that the FO spoke up, and the second is the person with more power (pilot upgrading to Captain) felt comfortable enough to violate SOPs (the setting of the altitude selector as the Pilot Flying) during a flight deck conflict. When the upgrading Captain set the altitude selector, they were doing the duties of the other pilot. They were micromanaging the pilot monitoring (the new hire FO). *Micromanaging* was a recurring theme in many interviews.

In another interview, the interviewee (a First Officer) explained this phenomenon in a single comment: "The most annoying thing, I think, for most pilots is if the other

pilot's trying to micromanage 'em [them]. Obviously an FO will never try to micromanage a captain, so it's a captain issue."

I asked the interviewee why they thought Captains micromanaged.

> It's insecurity, I think. They don't feel comfortable letting you fly your way. Yeah. And they need it to be done their way because that's how they know they can react or that's how they know they can deal with something if it goes wrong. I think it's a control and a lack of confidence. I think it's usually weaker captains that try to micromanage.

It was evident that micromanaging was *originating by* the Captain and *done to* the First Officer. What I wanted to explore was the impact micromanaging had on psychological safety and how this was manifested within the flight deck. This line of exploration led to my data-driven code of "bare minimum".

7.2.3 First Officers' Manifestation of Reduced Psychological Safety: Doing the Bare Minimum

After hearing stories of First Officers being micromanaged, I asked all interviewees how mannerisms or behaviors of FOs may have changed after being micromanaged. One interviewee explained with much emotion:

> You sort of, you feel like, oh, okay, like we're not gonna chat. We're not gonna talk. We're not gonna get to know each other at all. It's just gonna be about work from here on out. I'm just gonna do my checklist and I'm gonna sit over here in my seat." They elaborated, "you almost sort of disengage. You're just kinda like, okay, we're not, we're not doing this together anymore. I'm just going to sit here quietly, shut up.

The description was a clear indication of psychological safety being reduced in the flight deck.

This interviewee believed the micromanaging created a fissure in the lines of communication. It is interesting to note that in order for the FO to feel disgruntled by the lack of small talk (e.g., chatting) with their Captain, there must be an expectation for pilots to engage in casual conversation. The emotion-laden comment, "I'm just going to sit here quietly, shut up," suggests there is a social norm around pilots engaging in interpersonal communication, despite it not being required by SOP.

Having established a social norm of an expectation for casual conversation (that is, not mission-specific communication) in the flight deck, the removal became a manifestation of low psychological safety. This phenomenon was evident from the interviewee's portrayal of their experience with low psychological safety in the flight deck. I asked how they responded after experiencing a reduction in psychological safety. They stated, "I'll just, um, stare ahead, you know, stare at my own flight path,

stare out my own window. If I have to, I'll pull a checklist. If he calls for gear, I'll lower the gear, but I'm not going to do anything above and beyond the checklist."

The interviewee's comments make it clear that there is an expectation for non-mission-specific interpersonal communication. When psychological safety is reduced or undermined, the other pilot (often the one in the lower position of power, the FO) demonstrates this reduction by no longer engaging in interpersonal communication. They still engage in mission-specific activities, such as checklist reading and responding to aircraft configuration commands (such as lowering the gear) but disengage or avoid interpersonal communication.

The recurring theme was that First Officers demonstrate their frustration to a reduction of psychological safety by withholding interpersonal communication. They do the bare minimum and weaponize (by withholding) the social norm of casual conversation in the flight deck. This phenomenon is expressed and coded as *the bare minimum*.

Similar sentiment was expressed by another pilot:

> Over time I start to get more defensive and then it's just kinda like, well, I'm just gonna be the gear monkey then I'll just run the checklist. If he doesn't want to talk, then I won't do anything else. You know, I don't wanna be like that guy.

In an extreme example of this bare minimum, a third interviewee shared a time of observing a simulator session where the First Officer was the pilot flying and was being micromanaged by the Captain. In a demonstration of frustration at being micromanaged, the First Officer transferred control of the aircraft to the Captain and gave up their role as pilot flying.

There is a pattern: the First Officer expects interpersonal communication, experiences low psychological safety because of the Captain's tone and/or behavior, is frustrated, and, as a consequence, demonstrates frustration by *doing the bare minimum*. But the question then becomes, what happens when the Captain is incapable of engaging in interpersonal communication? The following interviewee example highlights this scenario:

The interviewee explains they were observing a flight simulator session, and the First Officer was "very talkative and talked through everything and was blah, blah, blah, blah, blah. And was talking through every decision and all, all these things." The Captain was becoming really quiet because his "partner was talking all the time; it didn't allow him to mentally process and mentally answer these questions and mentally find it for himself." After the simulator session, the Captain came up to the interviewee to express their frustration at the incessant communication by the First Officer.

The interviewee shared this story to illuminate that a lack of communication is not necessarily an indication of a reduction in psychological safety. When the Captain needed silence to process and was reluctant to engage in communication, the First Officer could have perceived this self-silencing as the Captain building a wall or siloing silo. The interviewee explained that perhaps the onus for resolving such a situation needs to be on the First Officer to self-reflect and "self evaluate and realize - 'oh, I'm very talkative.'"

This story highlights the dyadic relationship between Captain and First Officer in the productive outcome of CRM. Moreover, the story accentuates the necessity for self-awareness and the capacity for self-reflection within these interactions. The narrative of the overly communicative First Officer, whose behavior inadvertently impeded the Captain's cognitive processes, serves to underscore the importance of balance in communication. It suggests that the responsibility for mitigating communication breakdowns lies not solely with the Captain but also requires the First Officer to engage in introspection and behavioral adjustment.

This subsection illuminates a pattern wherein First Officers, when confronted with a perceived diminution of psychological safety due to the Captain's behavior, respond by retreating to task-specific communication and avoiding any non-mission-specific interaction. This behavior, conceptualized as “the bare minimum,” signifies a coping mechanism employed by First Officers to navigate the hierarchical structure of flight deck operations.

7.2.3.1 The Bare Minimum and Unintentional Non-compliance

I wondered whether the bare minimum phenomenon could lead to non-compliance, either intentional or unintentional. I explored this potentiality by asking interviewees their thoughts on the matter. The following interview excerpt highlights how non-compliance could emerge from poor CRM.

> I mean, I think it could lead to that. I don't think that there was, at least, in our situation. I don't think anybody intentionally, um, was non-compliant. Maybe there might have been unintentional non-compliance, you know, just because there was more stress, more distraction and, you know, maybe you get caught up in your own thoughts or, you know, if you are just staring out the window, you might miss, you know, a check or something like that. So yeah, it is, I think it [doing the bare minimum] could lead to increased non-compliance. I think, I mean, maybe it even in some people could lead to intentional non-compliance if they're just like, ‘okay, fine, I'm just going to sit here and not do anything at all’. Right. Um, it depends on the maturity of the person, maybe.

There exists a correlative relationship between adherence to Standard Operating Procedures (SOPs) and the construct of psychological safety within the flight deck environment. An anecdotal account from an interviewee provides an instance from the nascent stages of their aviation career, during which the actions of a Captain ostensibly compromised the level of psychological safety in the flight deck microculture.

> The Captain has made me so mad, and he is such a bad pilot. And, I was like - this is back when I was a new hire - I'm like, he's going to bust this altitude [note, ‘bust altitude’ means a pilot goes beyond their assigned altitude, which can result in a safety concern or negative repercussions by the Federal Aviation Administration]. I know he is going to bust this altitude, and I'm thinking: I’m just going to let him do it. You know, that's how negative it can be.

The story continued showing the linkage between compliance (not “busting an altitude”) and psychological safety (caused by a negative tone established by the Captain).

Similarly, another interviewee shared their sentiments after a flight where they experienced low psychological safety which created difficulty in completing the required debriefing. After the completion of a flight, crews are required to conduct a debriefing with specific items to discuss as specified by the airline. In this particular story, the interviewee linked the experience of low psychological safety to an erosion in their motivation to comply with debriefing protocols. There was a violation of Standard Operating Procedures caused by the reduction of psychological safety, as can be deduced from the following interview excerpt:

> There's really not a lot of motivation to do a strong debrief. You know, you're just kind of like, as soon as you shut down the engines, you're like, I just want to get out of this. You just get away from this guy” [Captain that eroded psychological safety]. “So, you know, it is not like, [mimicking a good debriefing] ‘Hey, what did we learn? … there's no - none of that kind of teamwork at the end. It's just like, all right, let's just do the minimum to shut down the aircraft, fill out the forms, and then go our separate ways.

A senior Line Check Pilot stated that the most dangerous occurrence at the airline is when a First Officer demonstrates low psychological safety by disconnecting. The interviewee explained what this disconnection looks like in the following excerpt.

> They [the First Officer] become the ‘window pilot’. Oh, they're kind of like, they check out and go, okay, well, I guess you're fine today. And they look out the window. And of course, that's the most dangerous of all things, um, uh, based on some things that are happening at [company name redacted] right now.

This disconnection, doing the bare minimum, is a result of a reduction in psychological safety. It is the methodology employed by First Officers to demonstrate their frustration with the Captain. This disconnection may lead to a reduction of safety through intentional or unintentional non-compliance with standard operating procedures.

One interviewee, who was sharing a story as a Line Check Pilot observing a crew from the jumpseat, explained this disconnection in the following manner:

> If they're looking at their iPad and or we've got three hours left and they're staring at approach charts, I know that they're absolutely not in it. They're not – there's no bonding. They just want to get this over with. And, you know, and [the] crew's fine, but, um, if I see the conversation limited to absolutely just necessary communication, then I know that they’re not gelling very well. And I worry that if there was a non-normal, would they be okay? I don’t know.

This described disengagement indicates a lack of effective communication and poor crew dynamics, which are critical for successful collaboration, especially in responding to unexpected events. The absence of rapport-building interactions raises concerns about the crew's capacity to operate cohesively under non-normal conditions, potentially compromising flight safety.

7.2.4 Summary of Insights into Flight Deck Behaviors in the Absence of Psychological Safety

When analyzing Research Question 5, the data indicates three key findings: 1) The leadership style of Captains can significantly influence the socio-dynamic environment of the flight deck. 2) First Officers often feel compelled to adapt to the prevailing microculture established by the Captain, a phenomenon termed the "chameleon effect." This adjustment leads to a reduction in psychological safety among First Officers, as they suppress their own preferences and behaviors to align with those of the Captain. And 3) reduced psychological safety among First Officers was observed through their tendency to engage in the bare minimum of interpersonal communication and task-specific activities, while withholding non-mission-specific interactions. This behavior serves as a coping mechanism in response to perceived micromanagement and siloing by Captains, potentially compromising effective communication and crew dynamics, thus impacting flight safety.

7.3 Flight Deck Behaviors to Build Psychological Safety

As with the previous research question, I took an exploratory approach using semi-structured interview data. I asked all interviewees to share the behaviors they believed would build psychological safety in the flight deck. I then asked them to share a story highlighting the recommended behaviors. Three recurring emergent themes were prevalent in the majority of the interviewees: tone, inclusivity, and finding commonality. Table 7.3 shows the themes embedded and derived directly from the data.

Table 7.3
Emergent Themes for Behaviors that Build Psychological Safety in the Flight Deck

Interviewee	Tone	Inclusivity	Commonality
1	X	X	X
2	X	X	X
3	X		X
4	X	X	X

5	X		
6		X	
7		X	X
8	X		X
9	X	X	X
10	X	X	X
11	X		
12	X	X	

7.3.1 Tone, Inclusivity and Commonality

An interviewee explained that lines of communication should be open, and this can be done by the Captain setting the tone of “we’re going to work together. We’re going to work as a team, let’s bring all ideas to the table.”

This interviewee offered an example of a recommended briefing that Captains could say to the First Officers when they meet for the first time in order to establish such a tone.

> I’ll make mistakes, please let me know. And then vice versa, I'll do the same for you. And then let's discuss any issues that might arise, and we'll work together to come [up] with a good solution.” They summarized by saying, “So set the tone of teamwork - so then the other person knows, ‘all right, we're all human, but we're going to get through this’.

For many of the interviewees, setting the right tone was a key component of building psychological safety. Oftentimes the emergent themes were interwoven across the same story. For example, an interviewee explained that the types of Captains they love to fly with are “just friendly even if they're having a bad day, even if they're tired, they show up and they're smiling.”

This pilot provided a nuanced elaboration, explaining that an individual’s communicative tone can be discerned through their interactions with others who hold comparatively lesser positions of authority, such as flight attendants and gate agents. They explained that good Captains are “very warm to the flight attendants. They're very polite to the gate agent”.

The following excerpt demonstrates how one interviewee believed a Captain can make the First Officer feel valued and included prior to starting a trip together.

> You know, they're, um, [pretending to meet someone for the first time], ‘Hey, you know, I'm so-and-so, how you doing? Where'd you come in from? How long was

> your drive? Like, you know, you got a family, you got kids, cool. You know, this is going to be a great trip. You know, what do you think about the flight? And I added a thousand pounds [to the fuel]. You know, what do you think?' You know, and kind of those, 'what do you think' questions make you feel like you're invested in working together. So that's kind of how I want to be.

This passage highlights the importance of creating a sense of belonging and value for a First Officer by a Captain before commencing a trip together. The interviewee suggests that a Captain should engage in warm, personal greetings, inquire about the First Officer's background, and encourage a dialogue about flight specifics, such as fuel considerations. By asking for the First Officer's opinions ("what do you think?"), the Captain fosters a collaborative environment. This approach exemplifies the three key themes identified in the research: establishing a friendly tone, promoting inclusivity by involving the First Officer in decision-making, and seeking common ground through personal engagement utilizing interpersonal communication. These actions are pivotal as they contribute to a psychologically safe microculture.

The import of non-verbal cues in establishing the "right" tone was recurrently underscored. For example, a non-prototype pilot explained that as a Captain they smile a lot to signify they are non-threatening. They stated that smiling helps to set an inclusive tone. They elaborated by saying, "I'm pretty soft spoken. Um, I don't talk loud. I I smile a lot. Uh, and I, you know, and I engage people in a manner that disarms them. That's how I roll."

Another pilot explained the importance of showing authenticity in setting the tone and the importance of doing it in the first few moments of meeting the crew. They explained, "if done correctly in those first few moments of briefing… it is going to either set that tone or it's going to set an expectation for an open tone, an open back and forth, and discourse. If overly done and not authentic -which I've seen - it can create a false sense of safety."

One pilot proclaims the necessity of employing a smile as a strategic non-verbal cue to establish a tone conducive to effective Crew Resource Management (CRM) and Threat and Error Management (TEM), while an alternate viewpoint cautions against the pitfalls of feigned gestures. These observations from the interviewees highlight the criticality of adaptability, acute self-awareness, and the nuanced capacity to interpret the individual with whom one is interacting within the flight deck.

7.3.1.1 Urgency for Setting the Right Tone Quickly

Many interviewees commented on the importance of setting the tone from the first interaction with the other crewmember. There seemed to be a sense of urgency in setting the right tone, as seen in the following:

> I mean, I think it starts from the first second that you meet somebody, it doesn't matter whether you walk in the flight deck and they're already sitting there, or whether you meet 'em at the gate or in the crew lounge, I think that tone, you have about 10 seconds to set the tone. And if you set the wrong tone, it can take

> you the rest of the trip to repair it. Um, so I think it's very important, especially with a new hire. So, if you don't set it right to begin with, it's really hard to reset.

The urgency of setting the right tone came as a consequence of not being able to repair the tone if established poorly. This sentiment was observed in subsequent interviews.

A fourth interviewee commented that you can surmise a Captain's tone by watching them interact with others. They explained:

> You might see that person interacting with someone else before they even interact with you. And you may already <laugh>, you know, you may already kind of know just from that interaction, whether it's the gate agents or [whomever], and you really get an idea just from those interactions even if you haven't talked with them much.

By observing the Captain's tone when dealing with others, coworkers are preparing for or getting a sense of how the Captain might interact with them. Essentially, observing the Captain's interactions with others is used as a metric for how the flight deck microculture may be established. There is a sense of urgency in setting the right tone with others quickly as the initial interactions that a Captain has with any crew member are instrumental in shaping the crew's perception of their leadership style and setting expectations for communication and behavior.

It has been determined that behaviors for establishing psychological safety include setting a tone of inclusivity and finding commonality between crewmembers. My goal was to understand just how this desired tone could be established and what methods might be used to create common ground.

7.3.2 The Mechanisms for Creating Psychological Safety in the Flight Deck

Some interviewees believe that the mechanism necessary for setting an inclusive tone included non-verbal communication, such as eye contact and body language. Multiple interviewees explained the importance of making eye contact, especially upon first meeting the crew. A senior Line Check Pilot interviewee stated, "nonverbal communication cues are probably the biggest [most important] one" in establishing psychological safety. Other mechanisms uncovered during the interviews for establishing an inclusive tone and rapport included showing vulnerability and using small talk.

7.3.2.1 Vulnerability

A senior line check pilot explained the importance of creating an environment where vulnerability is allowed, as seen in the following excerpt:

> I think it's very important that from the first minute of the first flight, you let these people [other pilots] know what you expect and that it's okay if they make a mistake because they're going to, there's no question about it. So, you have to set the bar right away saying, 'I know you're going to screw some things up, and I'm okay with that. It's all part of the process.'

This excerpt underscores the criticality of embracing vulnerability in the acknowledgment of flight deck error. Integral to the Threat and Error Management (TEM) framework is the pivotal role of threat identification and error disclosure. Acknowledgment of the inevitability of errors in the flight deck is a universally accepted tenet within aviation safety protocols. Leveraging vulnerability as a mechanism to engender psychological safety mitigates risk as it contributes to the cultivation of a flight deck microculture in which aviators are more inclined to concede mistakes and errors. Such a culture is essential for ensuring that errors are identified and rectified expeditiously, enhancing safety, and increasing the efficacy of the TEM model.

Another Line Check Pilot explained that the most important thing in establishing a crew relationship is authenticity. In their explanation of authenticity, their story highlighted the importance of vulnerability, as seen in the following excerpt:

> You could grab any pilot and say, 'what's the number one key to establishing an open, uh, relationship in the cockpit?' And they should be able to tell you, 'be authentic." They continued by stating that Captains should state a problem that First Officers can help them with, such as monitoring them when they taxi. They said, I just look at them and say, 'listen, I suck at taxiing and please help me with taxiing'. Or say, 'if you're going to be heads down, please tell me otherwise watch me like a hawk' - those kind of things. That's how you become authentic. That's how you create an environment that I guess it's okay to make a mistake or be vulnerable. That is probably one of the biggest keys.

This excerpt encapsulates the essence of fostering a culture of openness and trust within the flight deck, which is integral to ensuring effective Crew Resource Management. When Captains express their own vulnerabilities and actively solicit support from First Officers, such as assistance with taxiing, they not only humanize themselves but also signal that it is permissible to admit shortcomings and ask for help.

This admission of fallibility serves a dual purpose: it encourages First Officers to be more vigilant in their duties and it creates a collaborative environment where all crew members can feel comfortable disclosing their own vulnerabilities. In doing so, it cultivates a microculture where admitting mistakes or acknowledging areas of weakness is not stigmatized but is instead seen as a proactive step towards enhancing safety.

Another interviewee articulated that, in their role as Captain, they preemptively acknowledge the probability of personal error and underscore the necessity for all pilots to actively participate in monitoring. They explained in their interview that they turn to the other pilots in the flight deck and say, "there's a reason why we got four noggins in here right now" [note: four pilots in the flight deck is standard on long-haul flights with extended duty periods]. This strategy not only democratizes the flight deck hierarchy but

also serves as a proactive measure to enhance situational awareness and error management.
Another pilot explained the concept of vulnerability but labeled it “humility”:

> So, it's on the Captain's side [to open] the door by going, ‘Hey, tell me if I'm doing this, tell me if I'm doing that, I'm not perfect. I want you to let me know if I'm doing something that's dumb, different, or dangerous.’ You're making it where they need to take an action because you've told them to help you. So, it shows you don't know everything, and you may miss things. Yeah, so it's that whole humble piece of it, I think.

Interviewees recommended showing vulnerability by explaining to First Officers they are fallible and encouraging them to activate safety voice even on minor occurrences. This demonstration of vulnerability is a tool in establishing a flight deck culture characterized by psychological safety and by a tone that feels inclusive to those with less relative power (First Officers).

7.3.2.2 Small Talk

Finding commonality emerged from the data as a key element in fostering psychological safety. However, finding commonality requires shifting from impersonal to interpersonal communication, and there the mechanism used by many interviewees was small talk.

The concept of establishing shared experiences or commonalities surfaced as a pivotal factor in the cultivation of flight deck psychological safety within the research data. Finding commonality requires pilots to shift from the impersonal communication of standard briefings and checklist reading to the more personal style of interpersonal communication. The mechanism used by many pilots to engage in interpersonal communication is what interviewees labeled as ‘small talk’.

Another pilot showed perhaps a slight reluctance to small talk but explained its importance in setting the right tone.

> I think that just the first introduction and how they're doing. If you're doing the first day of [training] on a new hire, actually on a Captain as well, we call them a couple of days in advance and we get the small talk outta [out of] the way. You know, ‘hey, where are you coming in from? Where are you from? you married? You have kids, blah, blah, blah.’ So that's all done. Um, and that's part of setting that tone for day one of letting them know, ‘Hey, you know, this is just another pilot that I'm flying with. It's not some[one] I should be intimidated by’.

They underscored the previously identified imperative of promptly establishing a right tone, articulating, “it comes down to that first handshake … it's all about that first 10 seconds when you meet him” [note, the interviewee specifically said *him*].

So far interviewees have been observed using personal queries during conversational exchanges, touching on topics such as matrimonial status and

parenthood. A non-prototype pilot advocated for the use of more universal questions as a strategy to unearth shared interests, positing inquiries about musical preferences and literature. “I ask people, ‘what's your favorite music? Uh, have you read a good book?’ And so I try to stay in touch with what they're doing.” This approach is useful because it navigates the boundaries of personal and professional realms, aiming to foster rapport without encroaching upon potentially sensitive personal areas.

Another interviewee offered a similar warning as they explained the importance of avoiding certain topics during small talk. They stated, “the way I talk to people and teach new instructors and Line Check Pilots is, as I say, ‘treat every event or at least the first day on a trip like it's your family Christmas or Thanksgiving meal. You don't talk politics; you don't talk religion; you don't do off-color jokes. You just be a decent, kind human being’.”

Another interviewee suggested that small talk was encouraged by the company as a mechanism for setting the tone, as seen in the following excerpt:

> I think one of the things that we [company trainers] typically try to encourage [is a] really good job of setting the tone before any trip. We're supposed to meet together and we're not just talking flight planning, right? We're talking, ‘Hey, how's it going? What's going on at home?’ We're getting to know each other because odds are we've probably just met for the first time. And we've never flown together. So, we're kind of - it's, it's banter, right? It's a little bit of chit chat and, and just kind of establishing this safe environment to speak up and set the tone.

Such exchanges are not merely about imparting information; they signify an openness to engage on a personal level, thus fostering a sense of mutual understanding and commonality as a process to build psychological safety within the flight deck.

7.3.3 Other Data-driven Recommended Behaviors for Building Psychological Safety: Growth Mindset, Empathy, and Self-awareness

A non-prototype pilot interviewee explained the importance of a growth mindset (the belief that abilities and intelligence can be developed) and having empathy in order to build psychological safety, as seen from the following excerpt:

> Growth mindset and empathy are huge…if somebody doesn't have empathy or doesn't take the time to think about where the other person [is coming from], their background and what they've been through, they would make it hard to come to the common ground.

The necessity to have a growth mindset and empathy was substantiated by another interviewee whose comments exemplified these traits. This non-prototype pilot interviewee explained that even when they disagree with someone, it is important to not shut anyone down.

> I let them say their piece on whatever it is, and then just simply say, ‘well, I see things differently, but, you know, that’s fine.’ I just try and deflect to something that shows commonality. Usually that's how I deal with it, even if it's something outlandish that I think is way out of my realm or out of my comfort zone or whatever. I let them say their piece” and then move “on to whatever we find common ground on.

The first interviewee emphasizes that the capacity for empathy and the effort to understand the personal histories and perspectives of others are critical to finding commonality. The second interviewee's approach exemplifies the application of these principles in practice, demonstrating respect for divergent viewpoints and actively seeking areas of agreement. It allows for a diversity of opinions and experiences to be acknowledged and respected, fostering a culture where team members can voice concerns and activate safety voice, as opposed to participating in safety silence due to fear of dismissal or criticism. Collectively, the excerpts emphasize the vital role of empathy, self-awareness, and a growth mindset in safety, highlighting how empathy fosters understanding and cooperation among pilots, ultimately enhancing interpersonal communication and building psychological safety within the crew dynamic.

The second quote further reinforces this, showing that even in the face of disagreement, a growth mindset enables a pilot to remain open to other perspectives without becoming defensive or dismissive. This reflects self-awareness, where one recognizes their own reactions and deliberately chooses to seek points of agreement, maintaining an inclusive and psychologically safe microculture. Such an approach is beneficial for effective Crew Resource Management ensuring that different viewpoints can be aired safely, de-escalating potential conflicts, and increasing the likelihood that pilots will activate safety voice, which ensures efficacy of the Threat and Error Management model.

7.3.4 Summary of Flight Deck Behaviors to Build Psychological Safety

The analysis of Research Question 7 revealed numerous noteworthy findings on the behaviors that lead to psychological safety in the flight deck. Table 7.3.4 encapsulates the core outcomes of the inquiry.

Table 7.3.4
Captain Behaviors to Create Psychological Safety in the Flight Deck

Theme	Expanded Concept
Seeking Common Ground	Building psychological safety involves finding commonalities among crew members, fostering a sense of camaraderie and shared purpose that enhances communication and teamwork.

Establishing a Friendly Tone	Interviewees emphasized the importance of setting a friendly and collaborative tone in the flight deck, where Captains initiate open communication and teamwork from the outset.
Promoting Inclusivity through Involvement:	First Officers feel psychologically safer when they are actively involved in decision-making processes, contributing to a sense of inclusivity and mutual respect within the crew.
Utilizing Non-verbal Communication Cues	Non-verbal cues such as eye contact and body language are crucial for establishing an inclusive tone and fostering trust among crew members, complementing verbal communication.
Embracing Vulnerability and Authenticity	Creating an environment where vulnerability is accepted and authenticity is valued contributes to a culture of openness and trust, encouraging proactive error management and enhancing safety in the flight deck. Captains can demonstrate vulnerability by suggesting their own fallibility and eliciting First Officer feedback.

Overall, these key findings indicate that psychological safety in the flight deck is best achieved through a combination of behaviors that prioritize setting an inclusive tone, demonstrating vulnerability, and engaging in interpersonal communication to find commonality. These behaviors are interconnected and mutually reinforcing, highlighting their collective importance in creating a psychologically safe microculture within the flight deck.

7.4 The Role of Resilience in Building Flight Deck Psychological Safety

As discussed in Chapter 3, Section 3.4, resilience is a critical component for sociotechnical systems. As the majority of Pilot Safety Leaders (PSLs) believed psychological safety was important for effective CRM, I felt it important to understand how these safety leaders perceived the role of resilience in fostering a psychologically safe microculture.

In an attempt to answer Research Question 8, this subsection analyzes how resilience is perceived differently across institutional and social power dynamics. While some argue that Captains may need more resilience due to their leadership roles, others suggest that First Officers may require higher resilience levels due to their comparatively lower institutional authority. Additionally, I explore how social factors such as gender and minority status intersect with resilience, suggesting that historically

marginalized groups may be required to have higher levels of resilience due to workplace discrimination and a negative culture.

7.4.1 Pilot Safety Leaders' Interpretations and Definitions of 'Resilience'

One non-prototype pilot interviewee explained that resilience was "first mindset that we're going to reach our goal together and by having empathy it is going to help us work together better to reach that goal." They explained that to gain resilience one must be able to "view the world through somebody else's eyes." Their interpretation of resilience reflected sentiments of self-awareness and emotional intelligence.

> Another interviewee corroborated this connection when they said the following: Do they [Captains] take the time to put themselves in the shoes of the First Officer? The gate agent? You know, what did the agent have to do that morning? [They might have had to] ride the bus for two hours to get to the airport and went through all sorts of hoops to get to work that day, [just] to have people yell at them, right?

Other interviewees viewed resilience in a more utilitarian way. For example, an interviewee explained they had previously taught resilience as a process on "how to be more mentally prepared, and emotionally prepared or even physically prepared to deal with stress in extreme circumstances." When I asked this interviewee how they trained resilience, they offered, "I think if there was maybe a little bit more focus on health, like sleep, nutrition, exercise, you know, and how that leads to resiliency, that could be beneficial."

A third viewpoint of resilience emerged when another interviewee explained that resilience is the ability to "bounce back and rebuild the team." It's about getting "everybody back on the same page." This viewpoint was corroborated when a fourth interviewee defined resilience as "being able to absorb whatever circumstances [were] handed to you and process it and figure a way to still meet your end goal -- or at least to find a new end goal."

Other interviewees highlighted the necessity for pilot resilience stemming from the incessant scrutiny they face throughout their careers. One interviewee elaborated, "Well, yeah, I think good CRM is important and I think, you know, I think I alluded to it earlier that most pilots are fairly thick skinned cuz [sic] you spent your career being critiqued. So, the resiliency is there… if they start whining in the sim[ulator] about something not being fair or whatever, they're pretty much, they're shut down."

Another interviewee explained that when someone does not know their Standard Operating Procedures (SOPs) or does not call for the gear or flaps in the correct sequence, that can "impede resilience". This statement suggests that the adherence to SOPs is fundamental to the resilience of flight operations. The interviewee implies that deviations from established protocols can compromise the adaptive capacity of the crew, thus, intrinsically linking recovery potential of the system and the ability to maintain operational standards under variable conditions.

A fifth interviewee linked all of these concepts together in their interpretation of resilience, as observed through the following excerpt:

> Resilience, to me, is the ability to recover from a setback. A setback can be anything. Or the ability to not only achieve your goal, but exceed your expectations, especially under pressure. As pilots, we always face that. We always face the adversity part. We always face the pressure part. Because as a pilot, your life's about checkrides [recurrent training and testing often using a full motion flight simulator]. You're going to be taking one [checkride] all the time for the rest of your life until you hang it up. How do you become resilient in that process and not let it get to you? The other part being adversity - we all face adversity. It can be simple things like just the drive to work or it can be major things, life-changing things, [such as] the loss of a loved one. Um, anything like that. How do you deal with those? How do you go to sleep at night? How do you reframe situations? I'm a real fan. I teach reframing to almost everybody cuz [sic] I have to do it all the time or I'll be so pissed driving to work every day. I'm like, okay, [acting as though they are thinking] ‘I bet she just cut me off cuz [sic] she's headed to the hospital because her child just got sick’. So, yeah, cut her some slack.

This interviewee demonstrates an understanding of resilience as the capacity for an individual or system to recover from challenges or disruptions, which may range from mundane to profound. It further posits resilience as not merely returning to a prior state of functioning but also possessing the potential to surpass previously established goals, particularly in high-pressure situations. The concept of cognitive reframing is endorsed as a strategic tool for managing stress and fostering a more resilient mindset.

The collected data shows divergent interpretations pertaining to resilience. From emotional intelligence to self-care (sleep, nutrition, exercise), and having thick skin, a variety of definitions emerged. These interpretations span the domain of emotional intelligence to the pragmatics of self-care, encompassing sleep, nutrition, and physical exercise, and extend to the psychological robustness often described as having "thick skin." The multiplicity of definitions that have surfaced suggests that, should resilience be incorporated into the Crew Resource Management (CRM) and Threat and Error Management (TEM) frameworks, it would necessitate a precise definition. It would be essential for an organization to clearly define resilience in order to generate a shared mental model on its utility and practicality within the flight deck.

7.4.2 The Utility of Resilience

Other facets of the definition emerged as stories highlighted the utility of resilience. One interviewee viewed resilience as compartmentalization, as seen in this response:

> When you were talking about resiliency, it was like, compartmentalize, right?” They continued, “Um, I think that someone who is like maybe mentally checked

> out — maybe you started down that road of politics or religion, and now you've actually, you've hurt that forward movement of the flight operation - the place that you could become more resilient, you're now less resilient.

The interviewee continued to explain that grievances to the union or outside occurrences that elicit an angered emotion can be a threat “to the conversation, to the happiness or the wholeness of the cockpit crew. That could degrade the resilience. And it's important, you know, it's okay for us to be different.” The interviewee gave an example of differences and how those differences should not become a threat to the happiness or wholeness of the crew. The interviewee conceptualizes resilience as the psychological compartmentalization necessary for maintaining operational focus and emotional stability amidst diverse personal and professional challenges in the flight deck. This line of thinking continued.

Gesturing as though they were talking to a First Officer next to them, the interviewee elaborated, “You're a party person and you know, you'll never be married, never have kids. Oh, good for you. You know, tell me more. I'm a little bit interested in that, but I'm over here married, I have kids, and I love it.” This interviewee seemed to be suggesting that resilience was a necessary byproduct of the job because of differing backgrounds and personal life choices. In summary, the interviewee implies that resilience is not merely a professional attribute but a requisite outcome to navigate and reconcile the wide array of personal narratives and lifestyle choices that converge within the flight deck.

Later in the same interview, the utility of resilience was then linked to the previously discussed emergent facets of the definition: the concept of growth mindset and empathy, as seen from the following quote:

> When you feel safe at work, when you feel valued at work by your company or your union or colleagues, you want to do the best job and that helps us maintain our resiliency. There's a lot going on there that we have some downtime in crews, we need to make sure we stay alert. We want to learn from the other person by having an open mind.

The quoted material posits that engaging in informal dialogue and interpersonal exchanges within the flight deck is an inextricable aspect of aviation operations. Consequently, it necessitates the cultivation of resilience that serves a dual purpose: ensuring sustained operational vigilance and preserving the integrative socio-processes intrinsic to the sociotechnical system of the flight deck environment. This resilience is essential for maintaining the delicate balance between task-focused communication and the social interactions that underpin effective crew coordination and collaboration.

A few other interviewees corroborated the utility of resilience by suggesting that it is a required tool to operate as a pilot. One interviewee explained that Captains may need extra resilience when dealing with people who may lack it, as seen here: “as a Captain, I might be dealing with somebody who's maybe sensitive or emotional or, or whatever, um, or they're maybe not as resilient or mentally tough, you know, then it's my job to make them feel comfortable cuz [sic] that's who I'm working with.” This

statement suggests that Captains are required to exhibit a high degree of adaptability and employ strategies that cultivate an environment of psychological safety, particularly when confronted with First Officers who may demonstrate diminished levels of resilience.

Pursuing further clarification, I asked the interviewee to expound upon the characteristics of individuals who may exhibit lower resilience and the methods by which such individuals could be identified. The interviewee attributed this variance in resilience to generational differences:

> And how people, like, especially in, like, a certain generation, and I hate to label generations, but there is a shift. I don't know the last like 10 years of people who are - like, they're taught that words are violence and that, um, intent doesn't really matter. It's just how I feel. And, and I think that leads to a hypersensitivity and maybe like a catastrophizing of something that is not a catastrophe. And so, I think that could make people less resilient mentally, so they might take offense to something that's relatively benign. Um, I don't know how you really address that within an airline culture. I think that's more of a broader societal culture.

The interviewee suggested that newer generations may exhibit a heightened propensity to interpret non-critical events as severe, possibly undermining their capacity to demonstrate individual resilience. In the context of the flight deck's safety systems, which rely heavily on clear communication, this evolving social norm suggests the necessity of adaptability in CRM/TEM pedagogical frameworks in order to ensure they remain effective over time.

The response made me aware that there may be an intrinsic variance in the resilience levels among distinct demographic cohorts, as perceived by some of the interviewees. I began to wonder whether certain groups had to manifest higher levels of resilience as an adaptation due to their workplace culture. This led me to ask more probing questions on the matter in subsequent interviews.

7.4.2.1 Institutional Power and the Need for Resilience

A prototype pilot interviewee suggested that Captains may need to have more resilience than First Officers, especially when flying with a younger generation whom they deemed to be hypersensitive or less mentally resilient. Conversely, a non-prototype pilot interviewee argued that First Officers must demonstrate a higher level of resilience than Captains due to their relatively low position of power.

The non-prototype pilot interviewee explained that pilots with less institutional power need more resilience because they [First Officers] must realize “where they stand as it comes to the final word”. This viewpoint is more clearly elaborated in their comment below:

> When it comes to things, whether it’s techniques or thoughts, they are going to rest with the PIC [Pilot in Command, e.g., the Captain]. So, in my eyes, you need

> to have some resilience when it comes to things that maybe aren't going your way. You just can't sit over there hollering…and having a fit.

The interviewee expounded upon their argument, stating that an increase in the degree of empowerment correlates inversely with the necessity for substantial resilience. This is premised on the notion that an enhanced sense of inclusion within the system—or "feeling more part of the game," as they articulated it—diminishes the requirement for one to exhibit resilience in the face of adversity.

There exists a divergence of perspectives regarding resilience in the flight deck hierarchy. Some believe Captains must possess a heightened level of resilience to compensate for a perceived deficiency in resilience among First Officers. Others believe First Officers must exhibit greater resilience due to their comparatively diminished institutional authority and the consequent necessity for adaptability.

Upon analysis, it becomes evident that both propositions are valid. The endeavor to definitively ascertain which role—Captain or First Officer—demands more resilience is arguably an exercise in futility. The salient insight derived from this research is the imperative for the aviation industry to foster resilience in pilots. However, there must be an establishment of a consensus on the definition of resilience within the industry and pilots must be trained on methods to increase resilience and recognize its utility.

7.4.2.2 Social Power and the Need for Resilience

I continued this exploration of whether power was a moderator in establishing the required level of resiliency amongst pilots. The next non-prototype pilot I interviewed explained that individuals with more resilience are less negatively impacted by diminished psychological safety, as can be seen in the following:

> Anybody could exhibit lower psychological safety regardless of their title - [of] their position. I think anybody could find themself in a position of diminished psychological safety. It depends first and foremost on the resilience of the person… A person's ability to endure adversity creates resilience and, um, and it's a good tool to have, it's a good skill.

I acknowledged this statement with a follow-up question:

> Interviewer (me): "And do you think certain types of people have had more practice at being resilient?"
> Interviewee: "Yeah, absolutely. I think women and minorities have, um, first and foremost, have had to be more resilient, uh, in society. So [they] probably come to the flight deck with a higher level of capability of [being] resilient."

Previously, I had been focusing my research inquiry on resilience across the lines of institutional power. Now, I had an interviewee suggesting resilience also crossed the lines of social power. In response to a probing question, the interviewee affirmed the argument that certain demographics, notably women and minorities, have

historically been compelled to cultivate resilience out of necessity due to societal structures of inequity. Thus, these individuals may bring a more developed resilience to professional environments. This perspective broadens the discussion beyond institutional power dynamics, proposing that social factors and personal experiences significantly influence individuals' resilience.

7.4.3 Resilience & Social Power: Stories of “The Big Three” (Racism, Sexism, and Bigotry)

Early on in the interview process, I interviewed a senior Captain who told me there were three “big-ticket items” that impacted culture. They explained that these big-ticket items are ubiquitous and omnipresent. They are woven into the fabric of our society. *The big three* impact every facet of culture: the macro culture of our society at large and the microculture of our flight decks.

The following highlights the interviewee’s insights on the pervasive influence of social power on the flight deck microculture.

> I said that the big-ticket items - the items that we cannot escape from in this nation or in our industry and whatever industry – the big items are that racism exists, that sexism exists, and that bigotry exists. And we are, yes, making strides to overcome that stuff. And we have done – we've come out of it in so many ways, but we've had a lot of setbacks in so many ways.

This narrative underscores the entrenched societal issues that permeate the aviation industry. Although holding a position with considerable institutional authority, this Captain—a member of a demographic minority—demonstrates significant resilience as a means to counterbalance the diminished social power resulting from prevalent workplace racism. The dichotomy between the Captain's institutional power and their social power illuminates the complexity of power dynamics and the resilience required to navigate them.

7.4.3.1 Racism

The interviewee (an African American male Captain) shared a story of when they were flying a wide-body aircraft that required more than two pilots. In this story, both the Captain (the interviewee) and the First Officer were graduates from a prestigious military academy and had very similar career experiences. The third pilot (operating from the flight deck jumpseat) demonstrated racism when they attributed the Captain’s position to luck but the First Officer’s (a White man) position to hard work and merit. The interviewee recounted the story as follows:

> So, he kept on telling me how lucky I was to do the things that I did over my career. And I'm trying to listen to him tell, ‘you know, the other white guy - how lucky he was, you know, to be an academy grad and do whatever, blah, blah, blah.. ‘ You know, I'm waiting to hear all that luck for this other man.” He explained that he felt like saying, “you're looking all stupid. Just shut up.” But,

> instead he said nothing and explained that the silence took a lot of resilience. He continued, “That's my resiliency kicking in to be as professional as I can at all times. Doesn't mean that it always works because some people do deserve a piece of my noggin <laugh>. But you would have to hear him [jumpseater] and see all his splendor. [Imitating the jumpseater], ‘Oh man. He is just lucky. He is just lucky. Just lucky.’ I almost [said], ‘you tell me I'm lucky one more time, I might hit you in your mouth.’ You know, even I knew it was not a compliment.

This interaction epitomizes racial bias, demonstrated by the attribution of the African American Captain's professional achievements to luck rather than merit. This is contrasted with the acknowledgment of the White First Officer's accomplishments as a result of hard work and merit, despite both individuals having comparable educational backgrounds and career trajectories. The differential attributions based on race, where positive outcomes for a minority individual are ascribed to chance rather than ability or effort, is a form of microaggression that perpetuates racial stereotypes. It undermines the professional competence of the minority individual while upholding systemic biases that favor the majority group. The Captain's choice to maintain professional decorum in the face of such disparaging remarks is indicative of the resilience necessitated by such discriminatory environments. This interviewee’s story of racism in the flight deck was not an outlier event. More stories unfolded in subsequent interviews.

Racism frequently occurred in stories told by both prototype and non-prototype interviewees. One prototype pilot provided a retrospective analysis of an event that transpired at a former airline, distinct from the airline where the majority of the data for this dissertation was collected. The interviewee was a First Officer at the time. They were sitting in the flight deck parked at the gate getting ready to depart, and they had a pilot on the jumpseat.

The pilot in the jumpseat saw ramp personnel trying to get the Captain’s attention to request permission to disconnect the ground power from the aircraft. This is common practice in the airline industry. The interviewee interrupted the narrative with an awkward chuckle and said, “uh, and I can't believe this is going to be recorded, but I'm going to say it anyway [uncomfortable laugh]”

The interviewee continued with the story:

> Hey [pretending to be the jumpseating pilot talking to the Captain], I think the guy is trying to get your attention.’ The Captain turns, looks and sees this African American ramp agent waving his arms in the air. The Captain turns back to the jumpseater and he goes, ‘oh no, we were passing through this station last week, and [FO’s name] gave him a banana. He probably wants another banana.’

It is evident that the comparison made by the Captain, equating the African American ramp agent to a monkey, constitutes a flagrant display of racial prejudice.

The interviewee looked disgusted and said,

> Gosh. I wanted to open my window and jump out. That's how embarrassed [I was]. That's actually what the man said. Oh - and the jumpseater was like, ‘okay, [laugh]. Yeah. Okay.’ because he felt so comfortable with some other White guys

> that we can just – we could just marginalize an entire employee group based on [interviewee shakes his head indicating frustration but discontinues the sentence]…Oh goodness. Yeah. That happens.

This account serves as a stark illustration not only of blatant racism in the workplace but also of the creation of a hostile microculture by an individual in a position of authority, in this case, the Captain. The incident further implies the existence of a systemic issue where such behavior is tolerated, if not implicitly sanctioned, as evidenced by the jumpseater's reluctance to challenge the Captain's conduct.

A third story of racism emerged when a prototype interviewee flew with a senior Captain who had the distinction of being the second African American to have ever been hired at the company. The interviewee explained that the Captain referred to himself as “N2” (which can refer to an engine gauge labeled “N2” referring to the high-speed turbine section of a turbojet engine).

The interviewee initially failed to comprehend the significance of the term 'N2' as used by the African American Captain. Upon inquiry, the Captain elucidated, “Well, the first black guy was called ‘N1’." The interviewee recounts their shock in response to the recognition of the entrenched racial biases signified by such nomenclature. They continued, “I'm, oh my gosh. I'm like, oh my gosh. Oh my gosh. So, it [racism] runs deep and, um, I would like to say that most of that is gone, but we still have it.”

The narrative of racial discrimination continued with the testimony of another African American interviewee, who shared encounters underscoring a lack of representation in the aviation industry. The interviewee expressed their exasperation with being viewed as a novelty:

> I was talking to a guy who told me that he thought blacks were looking for a handout. It just went on and on - kind of a waste of conversation. But I will tell you what, knowing that these individuals let me know they have never seen a black pilot in their existence… all the first blackness, all the first female, this all ‘we’re the first’ thing…. [makes me] just kind of shake my head – they've been around for a long time.

The narrative shared by the interviewee represents a profound critique of the aviation industry's paradoxical celebration of “firsts,” particularly when it pertains to diversity. This is not merely an anecdote of personal frustration but rather a profound illumination of the absurdity inherent in the recognition of “firsts” in an industry that has, in reality, been populated by diverse individuals for a considerable duration. The interviewee's account serves as a poignant reminder of the persistent ignorance and systemic prejudices that pervade the aviation community and underscores the dissonance between the industry's self-perception and the lived realities of its diverse participants.

The chant of “firsts” in this context does not signify progress as much as it highlights the historical oversight and marginalization of contributions made by non-prototype pilots. This situation is emblematic of a broader systemic issue where achievements by non-prototype pilots are often overlooked or unrecognized until they are framed within the context of breaking new ground, despite the existence of

predecessors who may not have received similar acknowledgment due to systemic barriers and biases.

These four unique stories of racism reveal something of the pervasiveness of racism in the aviation industry, both the macro culture of our society and also the microculture of the flight deck. These stories highlight the existence of implicit and explicit biases and underscore the challenges faced by non-prototype pilots, demonstrating how success is sometimes attributed to luck rather than merit. The instances of overt racism, such as the derogatory comment made by a Captain, not only exemplify workplace discrimination but also point to a systemic failure in addressing and preventing such behavior. The interviews expose the need for a cultural shift in the industry, no matter how daunting, to eliminate racism, foster inclusivity, and challenge existing power dynamics that perpetuate discriminatory practices and exclusionary behavior.

7.4.3.2 Sexism

Transitioning to the next theme within the 'Big Three'—sexism—it is noteworthy that accounts of gender-based bias and discrimination emerged from the interviewees organically, unprompted by direct inquiry. This emergence suggests the deep-seated and pervasive nature of sexism. The subsequent narratives underscore the omnipresent influence of sexism in the aviation culture, signaling its insidious role in shaping the negative culture identified by the FAA Women in Aviation Advisory Board and summarized in their report's opening remarks: "The biggest barrier that discourages women from entering and staying in aviation careers is culture – and it is the hardest to change. Women don't feel like they belong." (Federal Aviation Administration, 2022, p. 3)

I asked one prototype pilot interviewee, "What is the role of being resilient? How does resilience relate to CRM and the flight deck?" The immediate response was a story of a woman Air Force Academy cadet experiencing sexism. The event occurred twenty years ago. A fellow graduate had told the interviewee, "There shouldn't be women there [Air Force Academy]. We should wash 'em all out." This particular narrative, albeit historical, resonates with contemporary accounts of the *women-don't-belong-here* exclusionary ethos from the 2022 report.

A non-prototype pilot interviewee recounted an experience with a male colleague during a flight a few years prior. During the course of the flight, the colleague engaged in a prolonged monologue, vehemently asserting the notion that women do not belong in the flight deck. The following excerpt exemplifies this sentiment.

> I had, um, a guy that I flew with years ago who spent most of a flight telling me about how - like, flat out - he was like, 'you know, women should be staying at home. They should be caregivers. The demise of this country is that women are out and working and they're not staying home and being moms.' And then he went on to tell me about his son and daughter and how his daughter was smarter, and she was better at sports. And that he felt it was detrimental to his son seeing that. And that he really had to reel his daughter in because she could

> crush him - she could crush her brother's spirit, just by being like this. And so, I mean, like genuinely, most of a flight was on that. [I was like,] oh, my goodness. And I just honestly listened and, you know, just like open-eyed. I genuinely think he forgot he was talking to a female [laugh]. I don't think he was doing it to be angry towards me or, you know, to put me down or anything. I just think this is how he talks to his dude friends too, right? Um, you know, I had let him wind himself out. So, I didn't tell him what he was doing was wrong or any of that kind of stuff, and just said, 'you know, it's got to be difficult to raise children. And, I just feel like I had a father who really encouraged me to do a lot of different things. And so that brought me here' [the flight deck]'.

Clearly, this is a flagrant instance of sexism. The male pilot's unsolicited proselytization, wherein he posits that the rightful place for women is at home as caregivers, not only reinforces antiquated gender roles but also suggests that women's professional ambitions are to the detriment of society. His further assertion that his daughter's intellectual and athletic prowess could be psychologically damaging to his son perpetuates a narrative of female inferiority and the need to suppress her to maintain male dominance. The interviewee's strategic response, which neither affirms nor directly challenges the colleague's views, reflects the resilience and adaptability non-prototype pilots must demonstrate in the flight deck. This interaction is emblematic of the systemic sexism that persists in the flight deck.

Later on in the interview, this interviewee said, "I'm pretty damn good at deflecting." The statement describes the pilot's adeptness at handling and deflecting instances of overt misogyny in the flight deck. Their skill in deflection suggests an ability to navigate and manage the negative behavior without allowing it to significantly impact their own well-being or performance. The pilot's capacity for compartmentalization indicates their ability to separate and isolate the negative experiences that might otherwise have affected other aspects of their professional or personal life. Despite facing explicit misogyny, this pilot remained mentally strong, maintained a professional demeanor, and demonstrated notable resilience.

The expression of proficiency in deflecting, illuminates the need for heightened resilience among women aviators. This deftness in handling and parrying incidents of blatant misogyny is not merely a reflection of personal strength but also a professional necessity imposed by the gender inequities prevalent in the field. The ability to navigate and mitigate negative behaviors without compromising personal well-being or professional performance is indicative of an additional cognitive and emotional burden that women pilots must shoulder.

The fact that such resilience is not a choice but a requisite for professional survival and success within the flight deck points to systemic issues within the industry that demand women cultivate and exercise a greater degree of resilience. This requirement can be understood as a form of tax on mental and emotional resources that is not equally demanded from their male counterparts (see section 4.6.1 of this dissertation), reflecting a broader societal pattern of inequity that intersects with professional expectations and norms.

Another story of gender bias came from a prototype pilot interviewee. I had just begun to ask about the concept of resilience and the flight deck. The interviewee explained, “Well, it means being able to be taken off task or to have a failure or to make a mistake and then be able to come back to center and continue going along a path of staying on task and recovering and yeah. Being ready for what else comes down.”

When asked if certain people have to exhibit more resilience in their lives, the prototype pilot interviewee shared a story of a woman Captain experiencing sexism at work. The interviewee explained that this Captain experienced microaggressions “over and over and over”.

The interviewee continued, “It's just, it's just every day, story after story, after story after story…” They explained a story of the Captain not in uniform asking for a jumpseat and being told “no” because the gate agent assumed she was a flight attendant (flight attendants are not authorized to sit in the flight deck jumpseat). Another story was about when she arrived at the gate in uniform with a young, male First Officer. Their flight attendant turned toward the young man for the crew briefing assuming he was the Captain despite her standing there in full Captain uniform. The litany of daily occurrences underscores persistent gender biases in the aviation industry. The interviewee summarized by saying:

> And she [the female Captain of the story] got to the point where she walks through a terminal defensively and she's trying to work on not always being defensive. And here I am with my little world experience going [gesturing as though the interviewee is explaining something to the female Captain], ‘you know, I wish you would just laugh at that stuff. Yeah. Just laughing off and, and show 'em [sic] that you're not bothered by it.’ And, she said, ‘well, [redacted for anonymity], that's an oversimplification of it. You haven't dealt with this; you haven't walked in my shoes for 20 years.’

The interviewee concluded by returning to the original question about resilience.

> Yes, I think there are people who do have to walk through – [interrupts themself] – who do have to deal with this all the time and yet be expected to put on that smile and go, ‘okay, ready for another trip’. Yeah, absolutely. I think women and minorities have, um, first and foremost, have had to be more resilient in society. So [they] probably come to the flight deck with a higher level of capability of [being] resilient.

The concluding remark from this interviewee acknowledges the reality that some individuals (in this case, women pilots) must routinely confront such biases while still being expected to maintain a veneer of professionalism and cheerfulness in their roles. This Captain’s experiences illustrate the concept of resilience not merely as a professional competency but as a daily necessity for navigation and survival in a gendered workplace.

The salient point of the narratives is the recognition that gender-based discrimination is an entrenched and enduring issue within the aviation industry, as

evidenced by the spontaneous emergence of sexism-related accounts from interviewees. This suggests that women pilots are compelled to cultivate an exceptional degree of resilience as a professional imperative, a necessity dictated by the persistent and systemic sexism they encounter, highlighting a critical need for industry-wide cultural and structural reform to address and eradicate such biases.

7.4.3.2 Bigotry

A common underpinning of racism and sexism is an inherent dislike for or prejudice against a group of people based on a loose categorization of the group as a whole, such as skin color, gender, or even generational differences.

Participants in the study highlighted intergenerational disparities as a pertinent issue impacting Crew Resource Management (CRM). One interviewee explained that the mix of generations in the flight deck is an emerging problem at their company, as seen in following:

> We are struggling with generational diversity at [redacted for anonymity], for lack of a better term. I mean, we've got 23-year-olds with 64-year-olds, because now some of our new hires are going to the right seat of the [a large aircraft, redacted for anonymity]. And so, for the first time in history, we are now getting, you know, some issues from that.

It was unclear from this interview whether the informant believed the generational problem emerged from a specific generation or whether it was the diversity in itself that caused problems. In a subsequent interview, the next informant appeared to shift the blame more specifically on the younger generation describing them as possessing an ‘entitlement attitude’, as seen from the following:

> It's the Captains - the more senior pilots - feeling that some of the new hires are insubordinate. I mean, that one [referring to reports regarding this issue] has just gone through the roof. We're not quite sure why. We're taking a close look at both sets of groups when they come through. I mean we really focus on CRM/TEM, and we actually have a program for some people that struggle with that. I think - it's what I hear from people that complain [is that] it's the entitlement attitude. Um, it really seems to be the problem right now.

In contrast, another participant in the study characterized the generational challenge as predominantly stemming from the attitudes of the older cohort of pilots. During this interview, a palpable sense of enthusiasm was expressed concerning the prospective retirement of this veteran group, a transition perceived as a catalyst for the broadening of human factors education. The informant provided further clarification, suggesting that the senior pilots exhibited a tendency to favor the status quo of Crew Resource Management (CRM) and Threat and Error Management (TEM) paradigms without alterations or advancements.

In terms of integrating advanced interpersonal skills as part of future CRM/TEM training, the interviewee explained:

> There is going to be some resistance from that large group [older generation]. But what is exciting about your opportunity is that I think something like a quarter of our pilots have been here less than 18 months. We're getting a whole fresh start. And so, there's a whole new generation who is ripe to learn this stuff and hear this stuff who's not just going to dismiss it because of some old generational, you know, preconceived notions or something.

These interviews reveal a nuanced perspective on generational dynamics impacting Crew Resource Management and Threat and Error Management in the flight deck. While acknowledging the inherent dislike or prejudice against certain generations, conflicting understandings emerge regarding which generation poses challenges in these areas. Essentially, there's a generational discontent, and it is being played out from both sides as another interviewee explained:

> Interviewee: "Yeah, I think there's generational differences in the expectation for psychological safety."
>
> Me: "And can you elaborate on your thoughts on that?"
>
> Interviewee: "Um, yeah, I think older generations are just, they come from a cultural mindset of 'you come to work, you do your job, you do what you're told, and that's it'. The younger generation was probably brought up in a more inclusive culture that, you know, 'you do your job, you solicit input, you value other people's input.'"

In this exchange the interviewee underscored the dichotomy in generational anticipations concerning psychological safety within the workplace. They noted that the older generations are inclined towards a conventional paradigm that privileges compliance and adherence to hierarchical directives. Conversely, the younger generation, shaped by a culture that espouses inclusivity, places a premium on participatory input and collaborative engagement, viewing these as complementary to the fulfillment of their professional duties.

A subsequent informant drew connections between generational identity and engagement with social justice movements. They referred to the younger generation as the "snowflake generation" and explained that some people want to distance themselves from anything that may appear "woke" or progressive, the Black Lives Matter movement, for example. This sentiment can be seen in the following:

> I will say there will be at least an initial challenge for some pilots - you know, the guys who [disliked] the Black Lives Matter [pins]. There's quite a few of those demographic who don't like anything that smells of, you know, making things soft or making things, um, you know, woke or making things progressive. You know, they're just sort of like, 'this is that snowflake generation'.

Institutionally sanctioned by the organization, pilots are granted permission to adorn their uniforms with specific insignia representing the Black Lives Matter movement and rainbow ALPA lanyards (signifying support for the lesbian, gay, bisexual, transgender (LGBT) community), signifying a formal incorporation of these symbols into their professional attire. Notwithstanding the narrative that positions these social advocacy symbols within a pejorative framework, associated with the term 'woke' as mentioned in the transcript, a divergent viewpoint was presented by another informant. This alternate view suggests a broader acceptance and institutional validation of social justice symbols within the professional context.

A senior Captain and prototype pilot interviewee described his practice of wearing a rainbow wristwatch band as a symbol of allyship. He deliberately employs this non-verbal cue to demonstrate his dedication to cultivating an inclusive and psychologically safe atmosphere for all colleagues, regardless of their designation as prototype or non-prototype pilots. This symbolic gesture extends beyond the traditional scope of LGBTQ+ allyship, aiming to convey broader messages of fairness and empathy. Its purpose is to provide reassurance to individuals of all identities, ensuring they receive equitable and respectful treatment. He explains:

> I am [in] the power position; I am the boss. I'm the instructor, I'm a wide-body Captain, so I now wear a nice rainbow wristband. It could offend some people…[but] it most definitely makes anybody marginalized or in another position – it makes them comfortable. They don't have to be gay. They could just be African American or Hispanic or a woman or whatever. And they're probably like, I think he's probably got it. Yeah. You know, I'm probably safe with [name redacted for anonymity] and, um, I love that!

The senior captain, acknowledging his relative power as a "wide-body Captain" and instructor, purposefully wears a rainbow wristband to advocate for inclusivity within the workplace. This deliberate action exemplifies a crucial aspect of allyship—recognizing one's own power and privilege and utilizing it to support individuals with less power. Leveraging his relative authority, he prominently displays the rainbow wristband, symbolizing a commitment to creating a psychologically safe environment for all colleagues. By doing so, he challenges conventional power dynamics and promotes equity among peers. This emblematic demonstration of allyship goes beyond superficial gestures, embodying a broader ethos of empathy and fairness. In effect, it fosters a workplace culture that values and supports diverse identities through collective solidarity.

A third interviewee, another senior Captain and a prototype pilot, viewed the pins, lanyards, and any other social justice insignia with staunchly opposing views. When asked about these company-approved insignia, they explained their opposition:

> I'm against that kind of stuff. Just because it's a red flag to me. Okay, the person I'm about to fly with is very opinionated - period. And it doesn't matter what - it could be a Trump lanyard, it could be a rainbow lanyard, it doesn't matter. But it

tells me they really strongly believe in whatever and they need to let people know that they think that which I really couldn't care less.

The last interviewee's dismissal of social justice insignia as a red flag and an indicator of their opinion reflects a perspective that may undermine allyship efforts. This stance negates the symbolic power of such insignia to foster inclusivity and fails to recognize their role in signaling support to marginalized groups, thus potentially perpetuating a workplace culture that reinforces the inequitable status quo.

The opinions expressed in various interviews illuminates the intricate landscape of generational expectations and their intersection with social justice campaigns within the aviation industry. The generational divide is not only manifest in differences in workplace ethos, particularly concerning psychological safety, but also in the broader societal context. Some informants suggest that older generations may view the workplace as a domain for compliance and execution of duties without question, reflecting a time-honored hierarchical structure. Conversely, another informant suggests that the younger generations, reared in a climate that promotes inclusivity, seek a more collaborative environment where their voices and contributions are valued, transcending mere task completion.

This cultural shift in expectations aligns with and is perhaps influenced by social justice movements that have permeated many aspects of society, including the workplace. For instance, the adoption of symbols such as Black Lives Matter pins or LGBTQ+ rainbow lanyards are emblematic of a generational embrace of progressive values. However, this acceptance is not universal. Some pilots view these symbols as indicative of an unwelcome “softening” or “wokeness” within the profession. Despite such divisions, there are efforts to bridge the gap, as illustrated by the senior Captain who adopts a rainbow wristwatch to non-verbally express solidarity with colleagues from diverse backgrounds, thereby contributing to an environment of psychological safety and inclusion across the generational spectrum. This gesture highlights a conscious attempt to mitigate generational discontent and underscores the multifaceted methods to show allyship and proactively create a more inclusive work environment.

7.4.4 Summary of Resilience Dynamics for Psychological Safety in the Flight Deck

Disparities emerged in safety leaders’ interpretation of the definition of resilience. Some asserted parallels between resilience and emotional intelligence, and their definitions encompassed empathy and a growth mindset. Others, rather than seeing it as an inherent trait, contended that resilience is shaped by the workplace environment through continuous evaluation processes and the expectation to compartmentalize. Though definitions varied, all safety leaders stressed resilience as key for navigating interpersonal dynamics within the flight deck.

Safety leaders unanimously acknowledged that resilience is indispensable for cultivating a microculture conducive to effective Crew Resource Management/Threat and Error Management (CRM/TEM), thus underscoring the pivotal contribution of individual resilience to interpersonal skills and an important facet of future human factors training. Overall, the findings suggest that individual resilience plays a crucial

role in building psychological safety within flight deck environments, and addressing both institutional and social factors is essential in promoting resilience among aviation professionals.

7.5 Chapter Conclusion

Research Question 6 investigated how low psychological safety manifests in the flight deck. I identified three themes: Captains' behavior can negatively influence microculture, leading First Officers to adapt in a chameleon-like manner, resulting in reduced psychological safety, minimal engagement, and interpersonal disconnection.

Research Question 7 explored flight deck behaviors contributing to psychological safety, revealing three core themes and their interconnectedness: setting the tone, inclusivity, and finding common ground.

Research Question 8 examined the impact of resilience on psychological safety, emphasizing pilots' ability to adapt and recover from disturbances. It acknowledged unique adversities faced by women and minority groups, suggesting they may possess greater resilience due to lived societal experiences. The section underscored the importance of resilience in the face of microaggressions, emphasizing its role in establishing psychological safety and improving CRM/TEM effectiveness.

The upcoming chapter will synthesize findings from Chapters 6 and 7, extracting meaning and building upon each other. By consolidating insights, I aim to construct a comprehensive understanding of flight deck dynamics, particularly regarding psychological safety, resilience, and their relationship to optimizing risk mitigation. These discussions are vital for advancing scholarly knowledge, informing practical applications, and facilitating evidence-based decision-making to enhance aviation safety.

Chapter 8 - Navigating Insights: Discussion and Limitations

8.1 Chapter Overview

The preceding two chapters presented the research findings. Chapter 6 delineated the results stemming from the quantitative data collection while Chapter 7 expounded upon the findings from the qualitative data. This chapter synthesizes and navigates through these findings via a comprehensive discussion.

This chapter explores the ramifications of positioning Pilot Safety Leaders (PSLs) as Subject Matter Experts (SMEs) and underscores the necessity of adding significant weight to their input. The chapter discusses PSLs' initial perplexity regarding advanced interpersonal skills concepts, followed by an analysis of their notable shift in their level of endorsement post-intervention. This discernible shift indicates their recognition of the importance of advanced interpersonal skills for future Crew Resource Management (CRM) and Threat and Error Management (TEM) training. While there was a statistically significant increase in the initial level of endorsement across all demographic groups, the longitudinal study reveals a subsequent decline in endorsement after 6-9 months, substantiating the recommendation for recurrent training.

Moreover, the chapter explores why non-prototype pilots, women and non-White men, exhibit a higher level of endorsement for interpersonal skills both before and after the intervention, suggesting that the negative culture prevalent in aviation (discussed in Chapter 4) may be more acutely experienced by non-prototype pilots.

The chapter introduces the Safety Voice Reduction Sequence model, which synthesizes research findings into a visual representation. While this model delineates the consequences of the absence of psychological safety in the flight deck, the chapter also highlights mechanisms for cultivating it.

Lastly, the chapter addresses limitations inherent in the study.

8.2 Positioning Pilot Safety Leaders as Subject Matter Experts in Crew Resource Management: Implications for Safety Training

The hypothesis testing from RQ1 confirmed that Pilot Safety Leaders had received more training on CRM interpersonal skills than the general population of pilots. That is to say, a larger percentage of PSLs could recall having been trained in specific FAA-recommended CRM skills than the pilots from the general population as measured from previous research (Perkins, Ghosh, Hall, 2024.). This is important as it positions the PSLs as relative experts in Crew Resource Management. This status gives greater significance to the responses from PSLs.

Positioning PSLs as CRM Subject Matter Experts (SMEs) is critical to future discussions analyzing their feedback and sentiment toward advanced interpersonal skills concepts post-intervention. Like any field, leaders often find greater value in the

insights of subject matter experts (SMEs) compared to those of inexperienced individuals. When we recognize someone as an SME, we give more importance to their insights.

As leaders in their field, PSLs possess valuable expertise that can inform the development and implementation of advanced interpersonal skills concepts post-intervention. Leveraging the input of SMEs, like the PSLs, enhances the credibility and relevance of safety training initiatives within the aviation industry.

The recognition of PSLs as SMEs not only acknowledges their advanced knowledge but also emphasizes the need to prioritize their feedback and sentiment in shaping safety protocols and training methodologies. As such, positioning PSLs as SMEs serves to elevate the quality and effectiveness of safety training programs, ultimately contributing to the enhancement of safety culture and effective training strategies to be used on the line pilots.

8.2.1 Examining Cultural Dynamics and Perceptions of Psychological Safety among Pilot Safety Leaders: Implications for Aviation Safety Training

It is one thing to be able to recall training subjects and another to endorse the meaning of the content. The findings from RQ2 show that Pilot Safety Leaders are not only knowledgeable (cognitive) SMEs, who recall their training on CRM, but also sincere (affective) advocates of it. The vast majority of PSLs understand the link between the FAA-recommended interpersonal skills and enhancing safety through improved CRM.

The FAA-recommended interpersonal skills received more positive responses than the advanced skills. However, the observation from subsection D.2.1.1, indicates a link between cognitive and affective processing from PSLs. That is to say, training PSLs on specific concepts to a level where when they can recall their CRM training (cognition) influences their endorsement (affect) of the concepts. This observation merits consideration, as it suggests that through structured and comprehensive training, it would be feasible to amend underlying adverse perceptions associated with interpersonal skills.

A portion of PSLs erroneously equate the concept of “psychological safety” with societal issues. They also manifest negative biases towards younger cohorts—an association not observed with the FAA-endorsed construct of sensitivity. There exists an undercurrent of resentment towards societal matters (such as generational disparities, race, gender, etc.). The term “woke” is employed pejoratively by some PSLs to diminish the value of interpersonal skills, particularly when any concept bears resemblance to the lexicon commonly associated with diversity, equity, and inclusion initiatives.

These findings underscore the significance of understanding how macro-level cultural dynamics impact microcultures within the aviation industry. The conditioning of pilots by their peers to harbor negative sentiments towards concepts they view as “woke” impedes the adoption of advanced interpersonal skills training. This observation suggests a broader cultural issue within the industry, characterized by latent anger and

overt discomfort towards such concepts. As elucidated in Chapter 4 and corroborated by the FAA WIAAB Report (2022), women experience a pervasive negative culture in aviation, which creates a barrier to workforce development initiatives. The reluctance observed among some Pilot Safety Leaders (PSLs) towards interpersonal skills aligns with this broader cultural pattern, which is even more evident in the responses from demographic inquiries (see section 6.5.1).

The dissertation's research aims to enhance safety through the optimization of risk mitigation strategies by focusing on the socio-processing capacity of crewmembers. An anticipated outcome of the proposed advanced interpersonal skills training could potentially alleviate the prevalent negative culture experienced by non-prototype pilots.

In addressing Research Question 3 (RQ3), it is evident that Pilot Safety Leaders (PSLs) exhibit a varied response regarding the importance of training pilots on advanced concepts. Specifically, there exists ambiguity and a lack of comprehension concerning psychological safety and its relevance within sociotechnical systems. Notably, interpersonal communication emerges as the most endorsed skill prior to training, potentially due to its familiarity with previous CRM literature. This finding holds significance as it underscores the prevalent misunderstanding of psychological safety, likely contributing to the unwarranted negative sentiment toward it. This finding emphasizes the importance of strategically integrating new interpersonal skills concepts within established safety frameworks.

These findings are important because they delineate the need for deliberate and comprehensive training strategies aimed at fostering a nuanced understanding of crucial safety concepts among aviation professionals. Failure to address these knowledge gaps may impede efforts to enhance safety culture and impede the effective implementation of critical safety measures within the industry.

Training initiatives focusing on areas beyond the status quo, such as emotional intelligence, self-awareness, and psychological safety, must be meticulously executed to mitigate ambiguity and prevent the emergence of negative perceptions. By anchoring such training within the sociotechnical framework, pilots can better appreciate the significance of these concepts in ensuring safety through risk mitigation, a universally recognized imperative within aviation.

8.3 Impact of Intervention on Endorsement of Advanced Interpersonal Skills Among Professional Pilots: Insights and Implications

It has been determined that the intervention has a positive influence by increasing endorsement for the three advanced interpersonal skills. This finding suggests that professional pilots are open to learning new concepts, including topics from social psychology and behavioral science, concepts not overtly discussed in current pilot training programs. While this finding may not be surprising, it warrants discussion as it frames the discussion around advanced future human factors training.

This pattern of endorsement, observed prior to the intervention, indicates that non-prototype pilots—those who do not fit the historically dominant demographic profile

of pilots—are more receptive to the inclusion of interpersonal skills within pilot training. This receptivity may be reflective of the distinct social barriers and professional challenges non-prototype pilots encounter, which can heighten their appreciation for the role of interpersonal skills in navigating the workplace. The data suggests that these pilots may perceive a direct relevance of these skills to their lived experiences and the potential for such training to mitigate systemic challenges.

This finding holds academic importance as it potentially reveals underlying differences in the baseline recognition of the value of interpersonal skills in CRM across demographic groups. The lower endorsement of interpersonal skills among White male pilots before training suggests deeper systemic or cultural issues in aviation, emphasizing the need for inclusivity and professional development to enhance safety within a diverse sociotechnical system.

Academically, understanding why White men exhibit the lowest level of endorsement for interpersonal skills and display adverse reactions to the incorporation of demonstrating sensitivity as a subset of CRM training is a topic ripe for exploration. The correlation between their lower endorsement rates and a heightened frequency of hypersensitivity to demographic inquiries could point to underlying systemic or cultural dynamics within the aviation industry. While this finding, which emerged organically from the data, is certainly intriguing, it falls outside the scope of this dissertation.

Human Resource departments that are tasked with formulating and justifying training programs to address the marginalization experienced by out-group members within the workforce can leverage this finding as a valid justification for such initiatives. This supports the argument that targeted training could be an effective strategy in mitigating the effects of marginalization and fostering an inclusive workplace environment all while being positioned as enhanced safety training.

8.3.1 Advanced Interpersonal Skills Must Be Offered in Initial and Recurrent Training

Another notable discovery underscored the necessity for recurrent training. Analysis revealed that after a lapse of six to nine months without training, the level of endorsement for these concepts declined across all demographic groups. This observation implies that advanced interpersonal skills should not only be integrated into initial training programs but also incorporated into recurrent training initiatives to sustain proficiency and reinforce comprehension (cognition) and endorsement (affect) over time.

8.4 The Safety Voice Reduction Sequence

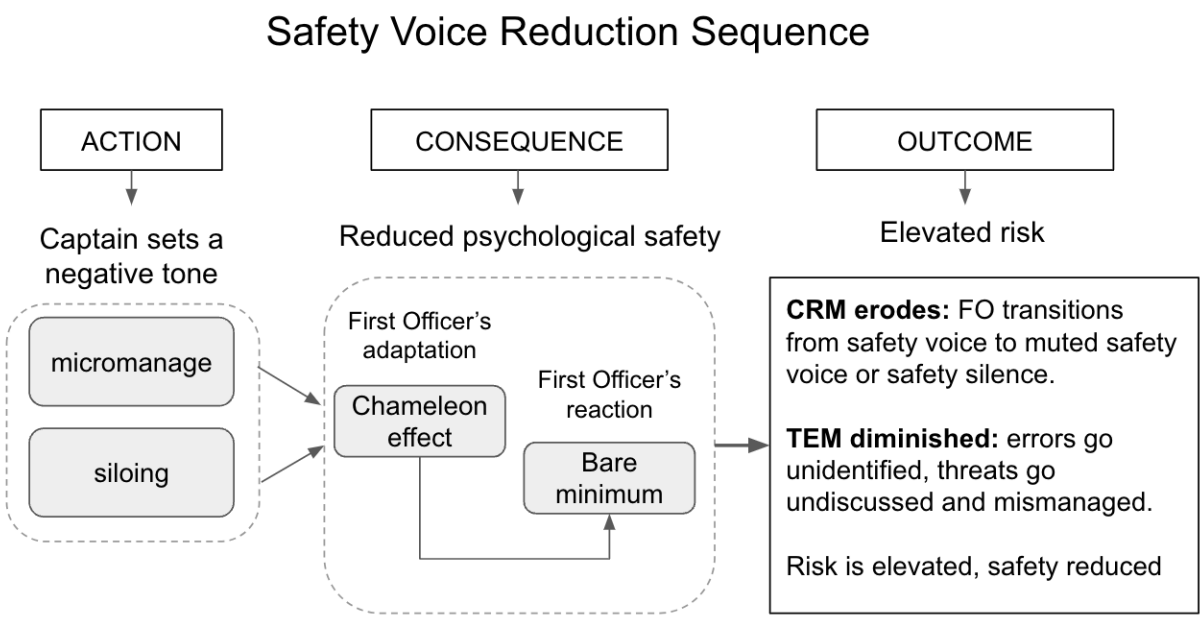
In researching how low psychological safety manifests in the flight deck across various positions of power (e.g., Captain vs. First Officer), a sequence was discovered. Figure 8.4 demonstrates how a Captain's tone or behavior (either through an action such as micromanaging or inaction such as siloing) can reduce psychological

safety. First Officers feel compelled to adapt within this microculture (chameleon effect); and they manifest their frustration by doing the bare minimum and withholding interpersonal communication. This, in turn, erodes the open flow of communication and reduces the efficacy of CRM/TEM.

When asked about this sequence and the potential erosion of CRM/TEM, one interviewee recounted their experience as, “well, I guess working in, living in their own silo. Yea. They, um, have built a wall around them, and they're not sharing any information. They're doing the bare minimum and not doing it in a way that is inviting or creates any of this sort of rapport with anyone else that's working around them.”

The act of self-silencing poses an escalation in risk. As pilots shift from an active safety voice to a muted safety voice, or, in more concerning instances, to complete safety silence, the ability to detect, contain, and address potential threats becomes significantly impaired. Consequently, the compromised state of safety precipitates a scenario where errors go unresolved, threats remain unnoticed or mismanaged, and risk is elevated. This sequence of events is identified in Figure 8.4, which I label as the Safety Voice Reduction Sequence.

Figure 8.4
Safety Voice Reduction Sequence



The erosion of psychological safety can have cascading effects on Crew Resource Management (CRM) and Threat and Error Management (TEM) as it reduces the socio-processing capacity. When communication channels are strained or closed off due to a lack of psychological safety, the efficacy of CRM and TEM processes is

severely undermined. This can result in miscommunication, coordination breakdowns, and an increased likelihood of threats and errors going undetected or unaddressed, ultimately compromising safety.

Furthermore, the impact of low psychological safety extends beyond the immediate operational context of individual flights. It can contribute to the normalization of suboptimal communication and decision-making practices within the organizational culture. Over time, this can erode trust, morale, and teamwork among crewmembers, which can lead to broader systemic issues that jeopardize safety across the various employee groups.

In summary, addressing low psychological safety within the flight deck is crucial for optimizing risk mitigation by addressing the socio-processing capacity of pilots. By promoting an environment where individuals feel empowered to voice concerns, share information and collaborate effectively, the efficacy of CRM/TEM can be elevated resulting in mitigated risk and enhanced safety.

8.5 Mechanisms to Generate Crew Psychological Safety

The exploration of flight deck behaviors aimed at fostering psychological safety outlined in Table 7.3.4 holds significant implications for aviation safety. The findings pertaining to behaviors critical for building psychological safety within the flight deck, including seeking common ground, establishing a friendly tone, promoting inclusivity through involvement, utilizing non-verbal communication cues and embracing vulnerability and authenticity, are imperative for ensuring pilots utilize safety voice effectively. They serve as a mechanism for generating psychological safety.

By seeking common ground, pilots cultivate a sense of camaraderie and shared purpose, facilitating open communication and teamwork conducive to safety voice. Establishing a friendly tone fosters an environment where pilots feel comfortable expressing concerns and engaging in safety-related discussions without fear of judgment or reprisal. Promoting inclusivity through involvement ensures that all members of the crew are valued and respected, encouraging active participation and the sharing of critical information necessary for safety voice activation. Embracing vulnerability and authenticity encourages pilots to acknowledge their fallibility and openly discuss potential risks, fostering a culture of transparency and proactive error management.

These mechanisms should be systematically incorporated to enhance pilots' capacity to operationalize psychological safety in real-world scenarios. To ensure proficiency, competency-based training and assessment methodologies should be implemented. This approach would provide pilots with practical opportunities to apply these concepts in simulators, allowing for feedback and reinforcement of desired behaviors. By incorporating these mechanisms into CRM/TEM training and adopting competency-based assessment strategies, aviation organizations can effectively equip pilots with the skills and mindset necessary to foster psychological safety and promote a culture of safety.

8.6 Defining Resilience in the Flight Deck: A Process-Centric Approach for Upholding Psychological Safety and Enhancing CRM/TEM Efficacy

Chapter 3 established that resilience in the flight deck is understood as the sociotechnical system's ability to maintain operational performance and safety amidst challenges. According to Woods (2015), this includes not only the capacity to recover to a baseline state following disruptions (Resilience 1) but also to gracefully extend and adapt to new and unexpected challenges (Resilience 3). The role of Crew Resource Management (CRM) and human factors training is critical in this framework, as it strengthens the interpersonal and adaptive skills of flight crews, enabling them to establish a psychologically safe flight deck microculture for the efficacy of the Threat and Error Management model.

Interpersonal skills training thus enhances the flight deck's resilience by preparing crews to both restore balance after disturbances (personal conflicts or disagreements, elevated moments of stress, etc.) and flexibly navigate unforeseen interpersonal dynamics utilizing a growth mindset and interpersonal communication to restore psychological safety in the microculture.

Using a sociotechnical systems perspective, the effectiveness of the technical system depends on the efficiency of the social processing within the social subsystem. The advanced interpersonal skills recommended in this dissertation offer a method to increase the capacity of the socio-processing subsystem within the dyadic relationship of the sociotechnical system. This training enhances the socio-processing capacity, that is, it enhances the capacity to effectively operationalize the observable behaviors requiring interpersonal skills to efficiently mitigate risk involved in operating the technology (the airplane). Increasing the socio-processing capacity enhances the resilience of the sociotechnical system, empowering pilots to mitigate the adverse effects of the safety voice reduction sequence and enabling them to implement behaviors crucial for establishing psychological safety. In essence, the system's resilience can be bolstered by training pilots in advanced interpersonal skills to effectively maintain an appropriate level of psychological safety to effectively ensure the activation of safety voice.

8.7 Limitations of the Research

This dissertation represents an interdisciplinary journey. It weaves together diverse academic disciplines in order to construct a holistic understanding of aviation safety, one that particularly emphasizes the activation of safety voice (see Chapter 3). In doing this, it leverages the lived experiences of marginalized groups (that is, non-prototype pilots) in order to identify and underscore the meaning of resilience and its role in sustaining an optimal level of psychological safety within the flight deck microculture in order to activate safety voice. However, there are limitations in synthesizing these varied insights into a coherent analysis, particularly when it risks

collapsing the diverse experiences of all non-prototypical pilots into a monolithic narrative. For example, suggesting that all women, or any group of non-prototype pilots, share the same experiential understanding of culture within the aviation industry is reductionist. It fails to account for the multiplicity of identities and experiences among women, influenced as they are by factors such as race, ethnicity, age, socioeconomic status, and more. Such a perspective risks overlooking the intersectionality of identities, which significantly shapes one's experience of marginalization and resilience in unique ways.

In a similar vein, the research presents a constrained examination of racial inequality. While the dissertation incorporates discussions on intersectionality and racism, there is a substantial need for further investigation to thoroughly understand the distinct systemic and social obstacles encountered by non-White aviators.

Another limitation lies in the scope of this research, which is restricted by the absence of the lived experiences of members of the lesbian, gay, bisexual, and transgender (LGBT) communities. The lack of data collected on the status of any of them by the Federal Aviation Administration (FAA) severely impedes the ability to measure their representation accurately. Future studies should endeavor to explore the unique experiences of the LGBT community as an underrepresented group within the aviation industry.

A fourth limitation is that this study exclusively focused on pilots in the United States. This was done intentionally so as to control for variations attributable to national culture. Nonetheless, this focus introduces a limitation in terms of generalizing the findings on a global scale.

The research done for this dissertation provides evidence that the ability to recall training content plays a crucial role in shaping an individual pilot's emotional connection to, and their subsequent validation of, the content's applicability as well as its significance vis-à-vis aviation safety (see section 6.5). In other words, it can be said that an individual's ability to remember instructional material significantly impacts their emotional reaction to it, which, in turn, influences their acceptance and perspective on the material's likely effectiveness and its relevance in the realm of flight deck safety protocols. Future inquiries, when done, could provide a deeper understanding of the methodological approaches and pedagogical techniques necessary to positively affect the learning outcomes of aviators from varied backgrounds.

While the identification of the limitations identified here not only clarifies the scope of the current study, but it also delineates potential avenues for future inquiry, which, when done, will contribute to a more comprehensive understanding of the subject and advance the conversations in our industry regarding interpersonal skills and advanced human factors training.

8.8 Chapter Conclusion

The chapter focused on deriving meaningful insights from the research findings. Given that Pilot Safety Leaders (PSLs) are Subject Matter Experts (SMEs), it is imperative to accord greater weight to their insights. Furthermore, those responsible for implementing

training programs would benefit from actively seeking buy-in from these SMEs. It was determined that the intervention had a statistically significant positive influence on SMEs, suggesting that these training concepts can be effectively extended to the broader pilot population. The finding that non-prototype pilots exhibited a higher level of endorsement for interpersonal skills both before and after the intervention may be attributed to their marginalization as out-group members, indicating the existence of a pervasive negative culture that requires addressing.

The Safety Voice Reduction Sequence was introduced to consolidate the findings into a visual overview, highlighting the significance of a Captain's behavior and the resultant behavioral response of the First Officer.

Mechanisms for fostering psychological safety were discussed within the context of risk mitigation. And resilience was discussed in relation to generating a psychologically safe flight deck microculture conducive to Threat and Error Management.

The chapter also highlights that enhancing the socio-processing capacity through advanced interpersonal skills training can effectively bolster the resilience of the sociotechnical system, enabling pilots to mitigate risks associated with the safety voice reduction sequence and fostering psychological safety for the activation of safety voice. In the following chapter, practical recommendations for implementing the research findings will be provided, along with final remarks.

Chapter 9 - Conclusion

9.1 Chapter Overview

Building upon the discussion points highlighted in the preceding chapter, this chapter introduces an innovative s-framed intervention strategy. It presents a novel model that redefines the approach to future human factors and human performance training considerations.

It advocates for strategic, s-framed intervention to augment safety and to diversify the pilot prototype; addresses the limitations of LOSA & FOQA data collection practices; and proposes ways of using that data to develop a method for measuring observable pilot behaviors. A newly created, cross-functional role is proposed to bridge gaps between various departments, ensuring a data-driven strategy for risk mitigation through advanced human factors principles. This role is pivotal as it calls for synthesizing data from LOSA, AQP, FOQA, and ASAP so as to shape training content that will enhance safety measures and help achieve diversity, equity, and inclusion goals.

The chapter discusses metrics for analyzing success, encompassing a diverse array of solutions utilizing existing data collection measures. The aim is to facilitate the implementation of this research seamlessly and expeditiously, without necessitating the development of new data collection frameworks.

The significance of this dissertation lies in its interdisciplinary approach, which blends insights from various fields and proposes a new, innovative framework for human factors training that identifies prioritizing inclusivity as a means to achieving safety.

9.2 Strategic S-Framed Interventions for Enhanced Safety

It has been established that s-framed interventions, over i-framed, are optimal for sustainable culture shifts (see section 3.6). The distinction between i-frame and s-frame interventions is critical, particularly within the domain of aviation safety. I-frame interventions, while insightful for understanding individual behaviors, risk obfuscating underlying systemic issues by overemphasizing personal responsibility for systemic failures. S-frame interventions, conversely, address the broader institutional and policy contexts that shape individual behaviors. They offer a more holistic approach to enhancing the efficacy of CRM/TEM by rectifying foundational assumptions that may not account for the complexities of human behavior within sociotechnical systems.

The integral role of psychological safety as a foundational element in the aviation sector's safety architecture is underscored by its critical influence on the activation of safety communication channels. An absence of psychological safety in the flight deck microculture inherently inhibits a crew member from using safety voice, which can lead to the retention of information (either through muted safety voice or safety silence) that

could be pivotal in mitigating risks and thereby undermines the integrity and efficacy of Crew Resource Management (CRM) and Threat and Error Management (TEM).

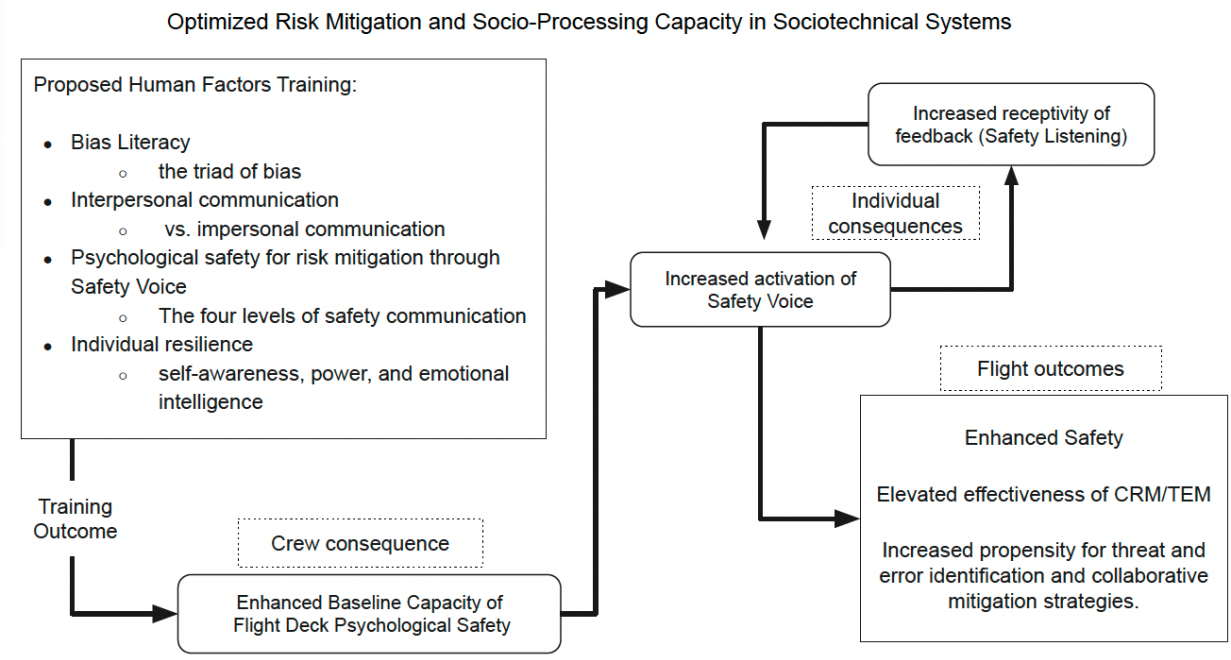
The research done for this dissertation led to two critical observations that underscore the necessity of focusing on s-frame solutions when addressing safety. First, the research identifies that pilots in positions of relative power in the flight deck are less likely to perceive the intricate connection between interpersonal skills and safety outcomes, particularly within the scope of Crew Resource Management's focus on sensitivity (see section 3.2.5). This finding demonstrates the value of a targeted systemic approach in training that bridges this cognitive gap. Secondly, paralleling the work done by others (Dugger et al., 2020), the research for this dissertation highlights a general tendency among pilots to score lower on measures of emotional intelligence. This finding is significant as it implies a potential lack of self-awareness among pilots regarding how their own attitudes, beliefs, and emotions can profoundly influence their behaviors. Such a lack of self-awareness can have cascading effects on the level of psychological safety within the microculture of the flight deck, ultimately impacting safety outcomes. Again, it becomes evident that systemic reform, not individual efforts, is key to strengthening CRM/TEM efficacy.

I propose a novel model designed for deployment via human factors training that will serve as a strategy to administer an s-framed training intervention. This model succinctly yet compellingly furnishes a rationale for the broadening of human factors training to encompass advanced interpersonal skills while including a focus on resilience. It is my aspiration that this model will be embraced by regulatory authorities and industry stakeholders to advocate for the augmentation and modernization of training protocols within flight schools, aviation organizations, and airlines.

9.2.1 The Optimized Risk Mitigation Model for Sociotechnical Systems

Figure 9.2.1 presents a model characterized by two notable attributes: the training content and the justification for it. Initially, it proposes the inclusion of specific training content in forthcoming pilot human factors training, as substantiated by the empirical findings of this dissertation. Subsequently, it provides a rationale for the broadening of human factors training and incorporates specific training content. This content is directly associated with the enhancement of safety outcomes and the refinement of risk mitigation strategies by increasing the capacity for socio-processes within sociotechnical systems.

Figure 9.2.1
The Optimized Risk Mitigation Model for Sociotechnical Systems



The model emanates from the theoretical framework established in the preceding chapters. Insights garnered from the investigation of the eight research questions enrich the content of the model and substantiate the imperative for its adoption.

Training individual pilots on both the advanced interpersonal skills competencies and resilience acknowledges and amplifies the foundational capability for fostering psychological safety in the flight deck. In this light, it enhances the capacity for socio-processing. Such an enhanced foundational state facilitates members within the sociotechnical system to engage in safety voice more effectively and to be more receptive to feedback. This enables a dynamic voice-feedback loop through which pilots can continuously learn from each other. It leads to enhanced Crew Resource Management (CRM) and Threat and Error Management (TEM) practices, which in turn translate to a higher likelihood of identifying and collaboratively mitigating potential threats and errors, ultimately improving flight safety.

9.2.2 Regulators' Role in Implementing the Optimized Risk Mitigation Model

Despite regulators and industry stakeholders urging pilots to engage in safety voice (see Chapter 2), the data shows pilots transition to muted safety voice and safety silence when psychological safety is not present in the microculture (see Chapter 3). The ethos and objectives of CRM/TEM are not fully actualized. Evidence in this dissertation suggests that industry safety leaders believe that the tenets of CRM/TEM can be better operationalized by the incorporation of advanced human factors training to include the advanced interpersonal skills. That research also provides evidence for the

conclusion that safety leaders believe the objectives of CRM/TEM can be better achieved by incorporating the advanced interpersonal skills into advanced human factors training.

The International Civil Aviation Organization's (ICAO's) endorsement of the empirical evidence and theoretical insights provided in this dissertation translated into actionable standards and recommended practices would be invaluable. Their involvement would ensure a comprehensive, system-wide approach to aviation safety that addresses foundational issues, enhances psychological safety, bridges training gaps, and ultimately leads to a safer aviation industry.

Civil Aviation Authorities, such as the Federal Aviation Administration (FAA) in the United States, possess the capability to independently mandate the enhancement of human factors training content, irrespective of the International Civil Aviation Organization (ICAO) advisories. Historically, the FAA has mandated the expansion of human factors training in response to legislative directives or to a sequence of accidents. For instance, a significant emphasis on Crew Resource Management (CRM) emerged following the 1996 Government Accountability Office (GAO) Report that called for changes. Similarly, leadership and command training became compulsory in the aftermath of multiple accidents, including and culminating in the notable 2009 Colgan Air crash (refer to section 2.3.2) (Federal Aviation Administration, 2020). While its traditional approach to such events and initiatives has been reactive, the FAA now has an opportunity to take a proactive stance in broadening human factors training without waiting for events that lead to Congressional directives.

9.3 Strategic S-Framed Interventions for the Diversification of the Pilot Prototype

It has been established that a pilot prototype has been explicitly designed and implicitly reinforced to exclude those not identifying as White and male (see Chapter 4). Despite the historical participation of women in aviation from its early days and the milestone integration of women into the professional airline flight deck some fifty years ago, the percentage of women pilots today remains alarmingly low. This persistence of gender imbalance raises critical questions about the effectiveness of the strategies employed to address these disparities. Perhaps the stalled progress is due, in part, to a too heavily focused dependency on i-frame interventions. This approach often includes initiatives aimed at raising awareness of unconscious biases through training programs designed to alter individual behaviors and attitudes and urges individuals to become mentors and allies.

This dissertation calls into question the effectiveness of unconscious bias training and similar individual-focused strategies (see section 4.7.1). It maintains that such initiatives unintentionally fail to address the systemic and structural barriers that contribute to the under-representation of women in aviation, just as it fails to address the systemic and structural barriers that contribute to the under-representation of non-White men and women (see Chapters 3 and 4).

This stagnation of progress stands in stark contradiction to the lofty goals and optimistic rhetoric presented by principal stakeholders in the industry. For example, ICAO's ambition for gender equality by 2030 (2022); IATA's 25by2025 initiative, which aimed at enhancing female representation increase to 25% by 2025 (2024); and ALPA's efforts “to foster a future generation of commercial airline pilots that better reflect the composition of the communities [they] serve” (2024) are all important goals but, absent an s-frame approach, they are not likely to be attained. Similarly, the FAA's dedication to reflecting the diversity of the nation it serves underscores a recognition of the importance of DE&I within the sector's operational and safety missions. So much so that an entire webpage has been dedicated to the topic by the FAA (see the Diversity, Equity, Inclusion and Accessibility webpage (2024)). However, the realization of these proclaimed objectives remains conspicuously absent, which suggests these declarations may, in fact, operate more as ideological aspirations rather than actionable commitments.

This discrepancy underscores the necessity of adopting a more expansive and systematic approach to effectuating substantive change. The current emphasis on diversity appears to be inadequately tethered to individuals’ altruism and the hope of allyship. To transition from ideologically driven declarations to tangible outcomes, it is imperative that the aviation industry undertakes a comprehensive reevaluation of its structural, policy, and cultural foundations.

9.4 Future Work: Utilizing LOSA & FOQA Data to Operationalize IATA/ICAO Observable Behaviors

Chapter 2 dedicates a subsection to identifying ways in which LOSA and FOQA could operationalize CRM (see section 2.4). It is the recommendation of this dissertation that these tools, alongside the observable behaviors (OBs) listed by ICAO and IATA and the FAA's behavioral markers, form a comprehensive framework for measuring the efficacy of the Optimized Risk Mitigation Model (see Figure 9.2.1).

Chapter 2 also demonstrates that pilots currently lack the tools to operationalize the expected behaviors (that is, they lack the necessary know-how to achieve the objectives stipulated by regulatory authorities). Imposing these behaviors as a mandate is a straightforward directive; however, fostering deep-rooted expertise that manifests naturally within Standard Operating Procedures (SOPs) presents a more intricate phenomenon, one that will require a reframing of current training paradigms. However, LOSA and FOQA can be leveraged to operationalize these behaviors and ensure pilots are adequately trained in creating psychological safety.

LOSA and FOQA can serve as evaluative instruments to gauge the efficacy of advanced human factors training programs, concentrating specifically on the capacity of pilots (the socio-processing capacity) to actualize the prescribed Observable Behaviors (OBs) and the resultant outcome in terms of risk mitigation. Such assessments are crucial for determining the extent to which training initiatives enable the internalization and practical application of advanced interpersonal skills.

While LOSA provides qualitative data on pilot behavior, FOQA offers quantitative data on how the aircraft is flown relative to established safety parameters. Together, they offer a holistic view of flight operations. FOQA data can be used to analyze macro-level trends in FOQA data over time and assess the impact of training on pilot performance and safety outcomes.

By operationalizing the observable behaviors listed by ICAO and IATA through LOSA and leveraging FOQA data, airlines can proactively mitigate potential risks through advanced human factors training as part of their basic introduction training and, more importantly, throughout their Advanced Qualification Program (AQP) (Federal Aviation Administration, 2017)

9.4.1 Limitations of LOSA to Operationalize CRM

As central as LOSA's role can be, the inherent subjectivity of its auditor's observations is a significant and fundamental limitation and warrants a warning. While LOSA observers are trained to collect data on pilot behavior and deviations from Standard Operating Procedures (SOPs) in an unbiased and systematic manner, the process is not immune to human bias. Observers come with their own experiences, perceptions, and interpretations, which can influence how they perceive and record events. This subjectivity can lead to variations in data collection and potentially affect the reliability and consistency of the audit outcomes. Despite efforts to standardize observation criteria, the subjective nature of human observation means that two observers might interpret or prioritize the significance of an event differently. To mitigate the subjectivity of auditors, ongoing training and calibration exercises are essential to ensure that observers apply the observation criteria consistently.

Such measures are crucial to guarantee the uniform application of observation criteria by observers. This dissertation proposes the establishment of a novel role designed to facilitate liaison with LOSA managers and trainers across various departments (see section 9.5 below). This role is designed to compensate for the limitations identified here and in section 2.4.

9.4.2 The Role of Advanced Qualification Program

The Advanced Qualification Program’s goal of achieving the highest possible standard of individual and crew performance (FAA, 2017) directly aligns with the objective of enhancing interpersonal skills. By setting a benchmark for excellence that surpasses current standards, AQP creates an environment where continuous improvement is not just encouraged but expected.

A critical aspect of AQP's efficacy is its emphasis on innovation in instructional methods and technology and on the efficient management of training systems. By fostering a culture of innovation, AQP facilitates the adoption of cutting-edge pedagogical strategies and technological tools that can significantly enhance the learning experience. This innovative spirit is crucial for developing and operationalizing IATA/ICAO’s OBs and the FAA’s behavioral markers, as it allows for the exploration of

new instructional methodologies that can more effectively engage learners and promote the competency of advanced interpersonal skills.

AQP provides an ideal platform for measuring training effectiveness in the advanced interpersonal skills because it combines a rigorous, data-driven approach to quality control with a commitment to innovation and excellence in training. The program's comprehensive framework enables the operationalization of observable behaviors, ensuring that training outcomes are not only measurable but also aligned with the overarching goal of the Optimized Risk Mitigation Model to increase the efficacy of CRM/TEM.

It is noteworthy that AQP incorporates data-driven quality control processes for validating and maintaining the effectiveness of curriculum content (FAA, 2017). it is through this platform that it becomes feasible to engage in an iterative refinement process of human factors training content, building upon, and enhancing previous iterations.

9.5. Enhancing Aviation Safety through a New, Cross-Functional Liaison Role: the Training Optimization & Data Integration Manager

This section advocates for the concerted collaboration among stakeholders involved in AQP, LOSA, FOQA, the Safety and Standards Departments, and entities tasked with the development of human factors training content. It would be advantageous for both the Safety and Standards Departments to appoint a liaison manager tasked with ensuring the alignment of LOSA auditor training, AQP data analysis, and management of human factors training content. This manager's role would be to optimize the use of data derived from LOSA and to minimize the subjectivity inherent in human bias. Concurrently, it would ensure that the data gathered is synergistically integrated with data from AQP and FOQA, thereby providing actionable insights for iterative enhancements to flight training content. The role's focus is on data management and strategic training development. This manager would be responsible for both the integration of various data sources to inform training practices and the oversight of training programs to align with the organization's strategic goals.

This manager collaborates closely with the training department, both in the context of foundational indoctrination training and advanced human factors training, with the aim of generating training content that reflects the findings from the company's data sourced by LOSA, AQP, FOQA, and other reporting avenues (Aviation Safety Action Program, internal safety reports, for example). The primary function of this role is to synthesize data from these disparate sources, thereby optimizing the utilization of this data to formulate actionable strategies for enhanced safety measures through employee training.

This role would be suitably positioned within the Standards, Safety, or Flight Training department, as it endeavors to operate in a cross-functional manner. The objective is to leverage the substantial volume of data available across these

departments, thereby facilitating the development of an effective data-driven strategy for risk mitigation through the application of advanced human factors principles.

9.5.1 Establishing a Nexus: The Case for a New Integrative Role

This dissertation emphasizes the importance of a collaborative approach among key stakeholders within aviation training and safety and standards programs, and the development of human factors training content. It proposes the creation of a new liaison role aimed at bridging the gap between various departments—Safety, Standards, and Flight Training and a liaison to ALPA's Professional Standards committee—to ensure a cohesive strategy in leveraging data for the enhancement of flight training programs. This liaison is tasked with minimizing the subjectivity of human bias in LOSA data, integrating it with AQP, FOQA, and ASAP data, and using this comprehensive data pool to make evidence-based improvements to training content.

The significance of this role lies in its potential to facilitate the transformation of aviation safety and training practices. By synthesizing data from multiple sources, the liaison can identify and implement improvements in human factors training, directly addressing the root causes of safety incidents and operational inefficiencies. This approach not only enhances the effectiveness of training programs but also contributes to a culture of continuous improvement and data-driven decision-making within the aviation industry.

Moreover, the establishment of such a role underscores a commitment to advancing safety standards through the application of scientific principles and rigorous data analysis. It represents a shift towards more integrated and adaptive safety management systems, where decisions are informed by a holistic view of operational data and human factors considerations. This not only enhances the immediate effectiveness of training programs but also sets a precedent for future innovations in aviation safety and training methodologies.

9.6 Metrics of Success

Consistent with the ethos articulated in the preceding subsections, which advocate for the recommendation of future work and the introduction of a new role in the airline industry, this section proposes metrics for evaluating success in the implementation of advanced interpersonal skills training and the adoption of the Optimized Risk Mitigation Model.

Direct measurement of the enhancement of interpersonal skills training may present a unique challenge. For that reason, this dissertation advocates for the collection of insights from secondary indicators to be used as metrics for success (e.g. a decrease in Standard Operating Procedures (SOP) deviations, reduced sick and fatigue callouts, a decrease in conflict-related calls to ALPA's Professional Standards, increased employee engagement through increased safety reporting, improved employee satisfaction, and the increased achievement of DE&I objectives). What follows is a brief analysis of the way each of these metrics might be used to assess the

effectiveness of advanced interpersonal skills training and its effect on the flight deck microculture.

Success Metric: Decrease in SOP Deviations

The empirical evidence presented in this study elucidates a noteworthy correlation between interpersonal skills conflicts among flight crew members and non-compliance with Standard Operating Procedures (SOPs) (see section 7.2.3.1). This correlation underscores the critical role interpersonal dynamics play in the adherence to established safety protocols and procedures in aviation operations.

Given that correlation, this dissertation postulates that the successful implementation of advanced interpersonal skills training has the potential to mitigate conflicts among crew members, thereby fostering an environment conducive to improved SOP compliance.

The effectiveness of advanced interpersonal skills training in reducing SOP non-compliance can be quantitatively assessed through subsequent LOSA data collection. By comparing pre- and post-training LOSA observations, researchers and practitioners can measure the direct impact of interpersonal skills enhancement on SOP compliance rates. A significant decrease in SOP non-compliance incidents, as recorded by LOSA following the implementation of the training program, would provide empirical support for the hypothesis that improving interpersonal skills among flight crew members leads to better adherence to SOPs.

Success Metric: Reduced Sick and Fatigue Callouts After the Start of a Trip

Sick or fatigue callouts during or after a trip starts could, in some cases, be a manifestation of underlying interpersonal conflicts within the flight crew. When crew members face unresolved conflicts, stress, or a toxic work environment, this may lead to psychological distress or a lack of motivation to work with certain colleagues. In such cases, some individuals might opt to call out sick rather than confront the conflict directly or endure a tense working relationship. Therefore, a noticeable reduction in sick callouts after the commencement of a trip could suggest the successful implementation of advanced interpersonal skills training as it would improve the flight deck microculture.

Success Metric: Decrease in Conflict-related calls to Professional Standards

Professional Standards calls are complaints or reports made by crew members regarding the conduct, behavior, or professionalism of their colleagues to their union (ALPA, for example). A high number of calls related to interpersonal skills issues can indicate pervasive problems in how crew members communicate, collaborate, and resolve conflicts. Therefore, another metric of success could be a reduction in interpersonal-related calls to Professional Standards.

Success Metric: Increased Safety Reporting

Employee engagement is a hallmark of a healthy workplace culture. It can be an indication that employees feel valued, involved, and connected to their work and the organization. Therefore, this dissertation argues that a third level of measuring the success of advanced interpersonal skills training in aviation involves evaluating broader

organizational outcomes that reflect the health of the workplace culture and the engagement of its employees in safety reporting. As has been well documented throughout this study, when psychological safety is apparent, individuals are more likely to engage, evidenced by individuals speaking up, offering suggestions, or reporting. It may be that employees withhold reporting safety concerns because they either do not feel comfortable speaking up (a lack of trust in the system) or they do not believe it will amount to anything meaningful (also a lack of trust in the system). Therefore, focused interpersonal skills training that leads to an overall increase in psychological safety may result in more pilots' participation in the safety reporting program.

In this light, an increase in safety reports can paradoxically be a positive indicator that reflects a higher degree of psychological safety and trust within the organization. When crew members feel comfortable and supported in reporting safety concerns without fear of retribution, it demonstrates an open, safety-first culture fostered by effective communication and interpersonal relationships.

Success Metric: Improved Employee Satisfaction

Employee satisfaction is directly influenced by the quality of interpersonal interactions in the workplace. Training that enhances interpersonal skills can lead to improved relationships, reduced conflict, and a more supportive work atmosphere, all of which contribute to higher satisfaction levels.

Using improved employee satisfaction as a success metric necessitates a multifaceted approach that encompasses the enhancement of interpersonal skills, the nurturing of a supportive workplace environment, and the active management of workplace dynamics. Such an approach not only contributes to the attainment of higher satisfaction levels among employees but also aligns with broader organizational objectives related to productivity, retention, and overall performance.

Just as the use of improved employee satisfaction as a success metric necessitates a multifaceted approach, so too does its evaluation, one that encompasses a variety of methodologies, including Human Relations surveys, retention rates, performance indicators, exit interviews, and feedback from management. Such a comprehensive strategy would provide a holistic understanding of employee sentiment and allow for a nuanced analysis of the factors contributing to workplace satisfaction. It would also provide for a well-rounded understanding of employee satisfaction and capture both the breadth and depth of employee experiences and perceptions. Moreover, ensuring anonymity and confidentiality in these processes would encourage honest and candid feedback, which would, in turn, enhance the reliability of the data collected.

Success Metric: Increased Achievement of DE&I Objectives

Interpersonal skills training enables organizations to build more inclusive, equitable, and diverse workplaces. This not only benefits the individual employees by contributing to the creation of a more supportive and understanding work environment. It also enhances the overall performance and competitiveness of the organization by leveraging the strengths of its diverse workforce.

The implementation of interpersonal skills training with a focus on these areas directly contributes to creating a work environment that is not only more welcoming but also actively supportive of diversity and inclusion. By doing so, such training initiatives play a crucial role in improving retention rates among employees from underrepresented groups. This improvement in retention is not merely a reflection of employee satisfaction but also an indicator of the organization's success in cultivating an inclusive, supportive, and equitable workplace culture. In the broader academic and practical discourse on organizational behavior and human resource management, the correlation between interpersonal skills training and enhanced retention rates among diverse employee groups underscores the importance of such training as a strategic tool for achieving DEI objectives.

9.6.1 Metrics of Success Summary & Limitations

This dissertation underscores the considerable advantages derived from utilizing the Optimized Risk Mitigation Model with specialized training in advanced interpersonal competencies. Such integration holds promise for enhancing CRM/TEM efficacy, mitigating some human biases, fostering inclusivity, and facilitating conflict resolution. It demonstrates that the success of these initiatives can be measured through a constellation of indirect yet indicative metrics, such as diminished deviations from Standard Operating Procedures (SOPs), a reduction in sick and fatigue callouts, fewer conflict-related reports to ALPA’s Professional Standards, and an uptick in safety reporting and employee satisfaction. These metrics collectively serve as a barometer for assessing the effectiveness of interpersonal skills training for illustrating its capacity to ameliorate flight crew dynamics, thereby enhancing SOP compliance, cultivating a healthier workplace microculture, and fostering a more inclusive and equitable organizational environment. Furthermore, the potential increase in safety reporting and improved employee satisfaction highlights the training's role in bolstering psychological safety and trust within the organization, essential components for achieving broader DE&I objectives. These positive outcomes directly enhance both operational efficiency and workplace harmony; aligning with the strategic goals of improved productivity, retention, and performance; and underscore the critical role of interpersonal skills training in building organizational resilience and competitiveness.

These recommendations come with some limitations. For example, changes in behavior and culture take time. It is essential to utilize a longitudinal analysis to monitor these indicators over an extended period to accurately assess the impact of training. Furthermore, various factors could influence the number of fatigue or sick callouts and the rate of Professional Standards calls. Therefore, certain control measures would need to be put in place to account for these (e.g., operational changes, external stressors) when analyzing data to ensure accurate attribution to interpersonal skills training. Lastly, this dissertation unequivocally advocates for a mixed-method approach. While this might be considered a limitation, it actually is not. The research done clearly demonstrates that supplementing quantitative data with qualitative feedback from surveys and interviews can provide deeper insights into the training's effectiveness and areas for improvement.

9.7 Conclusion - A New Framework for Human Factors Training

The research findings encompass a comprehensive exploration of key questions in the aviation safety domain. Firstly, safety leaders, identified as Pilot Safety Leaders (PSLs), exhibit a notably heightened level of proficiency in Crew Resource Management (CRM) compared to the broader pilot population, substantiating their expertise in FAA-recommended interpersonal skills. Secondly, PSLs overwhelmingly acknowledge the significance of FAA-recommended interpersonal skills for enhancing flight safety, with the majority advocating for the incorporation of sensitivity and adaptability in the flight deck. However, when it comes to the introduction of advanced interpersonal skills, there exists a degree of confusion, ambiguity, and hesitancy among pilots, which contributes to their being reluctant to embrace these new concepts prior to the intervention.

Furthermore, research demonstrates even a brief, focused intervention such as a one-hour lecture can significantly improve PSLs' willingness and ability to support the development of strong interpersonal skills. This highlights their flexibility and adaptability in response to targeted training efforts. This finding underscores the notion that PSLs are amenable to the introduction of innovative training concepts and are likely to integrate them into their professional repertoire just as they previously adopted training concepts recommended by the Federal Aviation Administration (FAA).

This adaptability is essential for maintaining high standards of professional conduct and safety within sociotechnical systems and demonstrates that targeted training initiatives can effectively bridge the gap between existing competencies and emerging industry standards.

A notable finding is that membership in a marginalized group, termed "non-prototype pilots" (see section 4.5), predicts a higher level of endorsement for both FAA-mandated and the advanced interpersonal skills training. This correlation underscores the premise that non-prototype pilots are likely confronting various forms of bias, necessitating that they rely on their individual resilience to navigate a professional workplace entrenched in prevailing norms and stereotypes that disproportionately disadvantage them. This insight is pivotal, as it reinforces the argument that the implementation of advanced interpersonal skills training is instrumental in achieving the objectives outlined in both safety and Diversity, Equity, and Inclusion (DEI) initiatives. By acknowledging and addressing the unique challenges faced by non-prototype pilots, such training endeavors to dismantle systemic barriers and foster an aviation environment that is more inclusive and equitable.

The professional pilot landscape is undergoing significant changes, with the demographic makeup of the flight deck gradually diversifying while generational differences diversify at a faster pace. As the demand for pilots increases, there's a noticeable influx of diverse age groups entering major airlines, a departure from the traditional career trajectory of spending years at regional carriers before moving up. The younger generation, raised in an era emphasizing diversity and inclusion, may expect a higher level of psychological safety in the flight deck compared to the more tenured generation, who may have experienced a pre-CRM-training hierarchical culture. These divergent expectations underscore the need for advanced interpersonal skills training to facilitate effective communication and collaboration across generations within the aviation community. Such training is essential for navigating cultural and generational

boundaries, mitigating biases, and fostering cohesive team dynamics, while also equipping pilots with the resilience and adaptability required to navigate the evolving aviation landscape for maintaining high safety standards. Ultimately, this training promotes an inclusive and proactive safety culture, contributing significantly to safe and efficient flight operations amidst the evolving diversity of aviation.

While examining broader cultural dynamics, this dissertation offers a larger macro-level perspective. It also addresses some of the nuances of the operations in the flight deck microculture. One example of this is the manifestation of low psychological safety in the flight deck. While not exclusive to any specific power position, individuals in positions of power tend to initially perceive their opinions as more valued. This is a fundamental aspect of psychological safety. Captains' behaviors, such as micromanagement and siloed decision-making, lead to First Officers adapting by exhibiting minimal engagement and interpersonal disconnection, thereby posing risks to flight safety. This study introduces the concept of a Safety Voice Reduction Sequence (see section 8.4). It illustrates how a Captain's actions contribute to a series of events that diminish communication effectiveness within the Crew Resource Management/Threat and Error Management (CRM/TEM) model.

Another example of the nuances in the flight deck can be seen in three flight deck behaviors, which are identified as building psychological safety: setting the tone, inclusivity, and finding commonality. Effective implementation of these behaviors can be seen in high-power individuals, like the Captain, demonstrating vulnerability by asking for or inviting feedback and showing humility, often by acknowledging their fallibility. Additionally, small talk serves as a mechanism to elicit interpersonal communication, which is a cornerstone for establishing psychological safety.

Finally, individual resiliency is universally acknowledged by safety leaders as essential in the flight deck. However, the research demonstrates that pilots, who are by virtue of the position expected to be safety leaders, exhibited disparities in their understanding of resilience. Some viewed it as something akin to emotional intelligence that would encompass empathy and a growth mindset (that is, the belief that everyone has the capacity to grow and develop). Still others understood resilience as a product of workplace factors and compartmentalization (a defense mechanism where one separates or "compartmentalizes" thoughts, feelings, and experiences that are difficult or conflicting, which allows them to avoid feeling overwhelmed or distressed) rather than as an inherent trait. Despite these varied perspectives, safety leaders universally recognized the importance of resilience in managing interpersonal dynamics in the flight deck and acknowledged its role in facilitating adaptability for both Captains dealing with First Officers of varying resilience levels and First Officers accommodating the authoritative role of the Captain. This research underscores the unanimous consensus among safety leaders regarding the indispensability of resilience in fostering a microculture conducive to effective Crew Resource Management/Threat and Error Management (CRM/TEM). Further, it emphasizes the central role of individual resiliency in shaping interpersonal skills and establishing psychological safety within the flight deck.

Resilience in the context of a sociotechnical system refers to the dynamic capacity of such an integrated network, where human, machine, and procedural

elements coalesce, to absorb disturbances, effectively rebound from disruptions, and return to a state of equilibrium or adapt proactively to anticipate future challenges. This sociotechnical systems capability ensures that the system not only maintains its functionality and robustness in the face of immediate shocks (efficacy of CRM/TEM) but also possesses graceful extensibility to proactively address and adapt to unforeseen conditions (such as interpersonal conflicts), thereby sustaining and enhancing overall system performance and safety. Therefore, it is by adopting the recommendation to train pilots in advanced interpersonal skills that we can make the flight deck more resilient.

9.7.1 Final Thoughts

This dissertation embarks on an interdisciplinary journey, weaving together diverse academic disciplines to construct a holistic understanding of aviation safety, particularly emphasizing the activation of safety voice. Central to this exploration is the conceptualization of the flight deck as a sociotechnical system, an approach that integrates elements of social and organizational psychology. This theoretical framework facilitates a nuanced understanding of the complex interplay between social processes and technical elements in Crew Resource Management (CRM) and Threat and Error Management (TEM) paradigms. By examining the flight deck through this lens, the dissertation aims to shed light on potent strategies for enhancing aircraft safety.

The research lays a foundation for optimizing risk mitigation by prioritizing and amplifying interpersonal skills (particularly bias literacy, psychological safety, interpersonal communication, and resilience) in a broader sociotechnical framework that would enhance aviation safety. It calls for a nuanced understanding of the interplay between power dynamics, emotional intelligence, and safety voice activation and advocates for training methodologies that not only enhance technical proficiency but also foster a deeper understanding of the psychological and social intricacies of the flight deck microculture. This methodology, as proposed, would enhance the socio-processing capabilities (namely, the interpersonal interactions and subsequent crew performance) in a sociotechnical system, thereby increasing safety levels and mitigating risk.

By embracing the recommendations laid out in this dissertation, aviation stakeholders—ranging from regulatory bodies to individual operators—have the opportunity to pioneer a transformative shift in aviation safety culture. This shift is not just about compliance or adherence to protocols but about fostering a work environment where every crew member feels valued, understood, and psychologically safe. The correlation between interpersonal dynamics and SOP compliance is a clarion call for a systemic overhaul of training methodologies, emphasizing the criticality of advanced interpersonal skills in human factors training.

The future of aviation safety hinges on our collective ability to recognize and act upon the interconnectedness of human factors, human performance, and technical systems (the very essence of sociotechnical systems). It calls for a holistic approach to safety management, where advanced interpersonal skills training becomes the linchpin in a comprehensive strategy for risk mitigation. This dissertation, therefore, is not just an

academic endeavor but a manifesto for change—a vision for an aviation industry where safety is not just engineered but woven into the very fabric of its human interactions. Let us commit to a future where the skies are safer, not just through the machines we build but through the people who pilot them. Let this be our shared legacy—a testament to the power of interpersonal skills, collaboration, and the relentless pursuit of excellence. As we embrace these challenges and opportunities, let us move forward, together, united.

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Appendix A - Professional Pilots' Perception of Demonstrating Sensitivity for Safety Enhancement

Reference 3.2.5

The study analyzed survey data concerning professional pilots' beliefs regarding the enhancement of safety through the demonstration of sensitivity toward other crew members' personalities and thinking styles, as specified by the FAA in the "Crew Resource Management Training" Advisory Circular (2004). The analysis focused on two key variables: social power, operationalized as gender in a binary form (distinguished between female and male) (see Table A.1.a), and institutional power, operationalized as seat position (distinguished between Captain and First Officer) (see Table A.1.b).

Table A.1.a
Female vs. male responses to "sensitivity" survey question

In your opinion, would safety be enhanced if pilots were required to demonstrate sensitivity toward other crew members' personalities and thinking styles?	Female N=	Male N=	Total N=
Yes	138	255	393
No	14	97	111
Total	152	352	504

Table A.1.b
First Officer vs. Captain responses to "sensitivity" survey question

In your opinion, would safety be enhanced if pilots were required to demonstrate sensitivity toward other crew members' personalities and thinking styles?	First Officer N=	Captain N=	Total N=
Yes	42	363	405
No	13	113	126
Total	55	476	531

To determine statistical significance, two tests were conducted. For the variables, I used female/male and yes/no (see Table A.1.a) and First Officer/Captain and yes/no (see Table A.1.b). First, a Fisher exact test yielded a statistical value of less than 0.00001, indicating significance at a threshold of $p < 0.05$. Secondly, a chi-square test yielded a statistic of 20.8064, with a p-value also below 0.00001 (X^2 (1, N = 504) = 20.8064, p = < .00001) (Social Science Statistics, n.d.). Both tests indicate statistical significance indicating that the observed results are unlikely to have occurred by chance. This implies the existence of a genuine relationship between social power (gender) and the perceived significance of interpersonal skills in enhancing safety.

I also employed the statistical tools to examine the relationship between institutional power (Captain vs. First Officer) and the perceived importance for the FAA-recommended CRM skill of demonstrating sensitivity toward other crewmembers for the enhancement of safety. The Fisher exact test yielded a statistic value of 1, suggesting the results are not significant. Similarly, the chi-square statistic recorded a value of 0.0619, resulting in a p-value of 0.80344. Thus, the findings lack statistical significance at the conventional $p < 0.05$ threshold.

Significant results are more likely to be generalizable to the broader population. They provide a basis for making inferences beyond the sample studied. While we cannot make any generalizations on how seat position may influence perceived importance, we can across the gender variable.

Understanding how gender intersects with attitudes towards safety is less about making a judgment claim and more about acknowledging that women, in general, may find interpersonal skills more valuable than men because they employ them constantly in the workplace to circumnavigate the negative culture rampant in the industry. Perhaps they must employ these skills regularly, and thus see their value, because they have been marginalized in the industry.

It is noteworthy that although the statistical analysis yielded non-significant findings, Captains exhibit a higher tendency than First Officers to misunderstand the correlation between demonstrating sensitivity and enhanced safety through better crew collaboration. Additional scrutiny of this observation holds the potential to provide valuable insights into power dynamics and the association between institutional power and the perceived importance of interpersonal skills.

Appendix B - Operationalizing Interpersonal Skills Constructs in Survey Design

Reference 5.3.2

Table B.1. provides a detailed breakdown of the constructs utilized in the survey, including their names, labels, and locations, which were instrumental in operationalizing these constructs during data analysis.

Table B.1
Interpersonal Skills Concepts Constructs, Label, and Survey Location

Construct Name	Construct Label	Construct Inputs
Leadership Adaptability	LA	S1Q8P4_S2Q1P4_S3Q1P4
Leadership Setting the Tone	LT	S1Q8P5_S2Q1P5_S3Q1P5
Demonstrating Sensitivity	DS	S1Q8P6_S2Q1P6_S3Q1P6
Psychological Safety	PS	S1Q8P2_S2Q1P2_S3Q1P2
Cognitive Bias	CB	S1Q8P1_S2Q1P1_S3Q1P1
Interpersonal Communication	IC	S1Q8P3_S2Q1P3_S3Q1P3

Appendix C - Testing for Bias in Survey Results

Reference 5.3.4.2

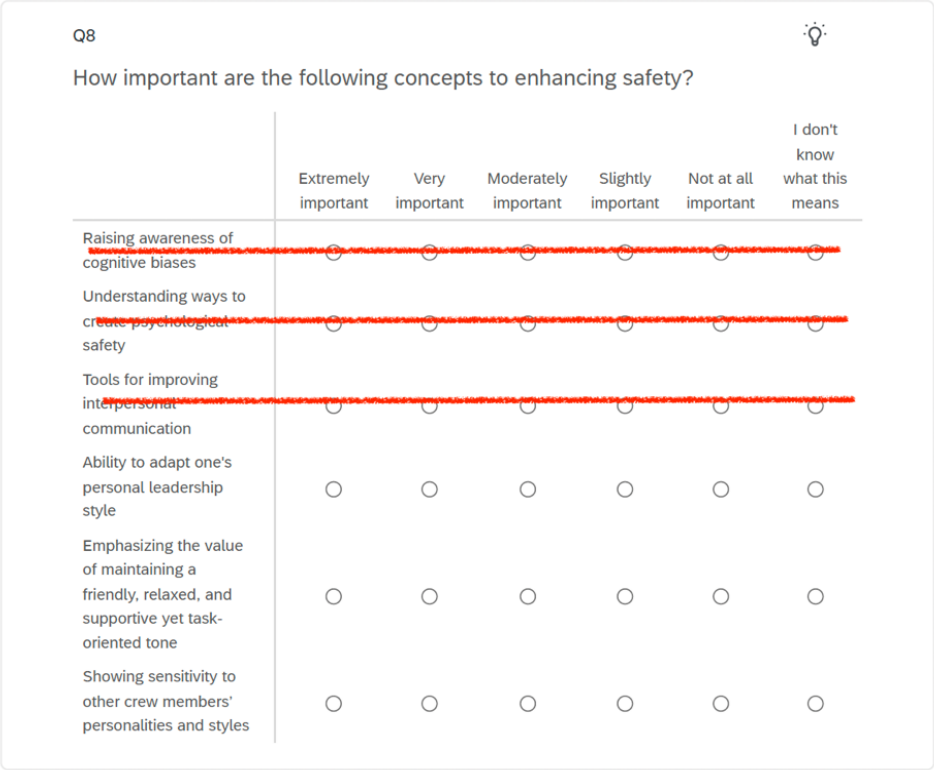
Figure C.1. illustrates the comparison between Surveys 1 for Groups 1-3, featuring all six interpersonal skills constructs (three from the FAA and three advanced), and Survey 1 for Group 4, where the advanced interpersonal skills are highlighted with a red strike mark indicating their removal.

Figure C.1
Survey 1, Question 8: Groups 1-3 vs. Group 4

Q8

How important are the following concepts to enhancing safety?

	Extremely important	Very important	Moderately important	Slightly important	Not at all important	I don't know what this means
Raising awareness of cognitive biases	○	○	○	○	○	○
Understanding ways to create psychological safety	○	○	○	○	○	○
Tools for improving interpersonal communication	○	○	○	○	○	○
Ability to adapt one's personal leadership style	○	○	○	○	○	○
Emphasizing the value of maintaining a friendly, relaxed, and supportive yet task-oriented tone	○	○	○	○	○	○
Showing sensitivity to other crew members' personalities and styles	○	○	○	○	○	○



I believe it is important to measure whether bias significantly influenced survey results. I was concerned that social desirability bias (a tendency of respondents to choose answers they deem more acceptable rather than a response that reflects their true thoughts) (Grimm, 2010) or expectation bias (respondent's expectation of outcomes influencing behavior) (Williams, Popp, Kobak, & Detke, 2012) or recency bias may influence how survey respondents answered questions. As described in section 5.3.4.2, I utilized a Wilcoxon Rank Test to measure whether biases, in general, influenced the responses.

In phase one of this test, I began by contrasting the responses from Group 4 with the combined responses of Groups 2 and 3. This comparison focused on the perceived significance of three specific interpersonal skills relevant to the FAA, as measured via Survey 1. These FAA-recommended skills can be seen below along with their abbreviated label that I utilize throughout this subsection.

- "Ability to adapt one's personal leadership style" (see FAA, 2004, Appendix 1, Section 2.b.2) (henceforth labeled *Adapt*).
- "Emphasizing the value of maintaining a friendly, relaxed, and supportive yet task-oriented tone" (see FAA, 2004, pg. 11, Section 12.b.2) (henceforth labeled *Tone*).
- "Showing sensitivity to other crew members' personalities and styles" (see FAA, 2004, pg. 11, Section 12.b.2) (henceforth labeled *Sensitivity*).

A five-point Likert scale was used, and the distribution is recorded in Table C.1 Utilizing a Wilcoxon Rank test, it was determined that the responses for these three constructs by Group 4 compared to Group 2 and 3 were not significantly different from

each other. As seen in Table C.1., the p-value for the construct of *Adapt* was 0.08212; for *Tone,* the p-value was 0.6775; and, for *Sensitivity,* the p-value was 0.1884.

Table C.1
Survey 1 FAA-constructs - No significant difference between Group 4 and Groups 2&3

Concept	Likert Scale Value	Group 2,3 N=	Group 4 N=	p-value (ignoring NA's), using the Wilcoxon Rank Test: Groups 2 & 3 collectively and Group 4
FAA: Adapt	5	62	39	0.08212
	4	96	79	
	3	36	49	
	2	14	6	
	1	1	1	
	NA	59	38	
FAA: Tone	5	84	59	0.6775
	4	89	91	
	3	29	22	
	2	9	2	
	1	1	0	
	NA	58	38	
FAA: Sensitivity	5	24	18	0.1884
	4	74	51	
	3	73	67	
	2	33	24	
	1	5	12	
	NA	58	39	

After establishing that the pilot groups were not significantly different in their responses to FAA-interpersonal skills concepts before the intervention, I next compared whether these two groups were significantly different in their responses post-intervention. All groups received the same Survey 2, Question 1, Parts 1-6 which measured responses to the three FAA-recommended interpersonal skills and the three advanced interpersonal skills introduced during the training intervention.

Analyzing the distribution of answer choice and a Wilcoxon signed rank test, we can measure whether these groups were significantly different in their choice selection for the advanced interpersonal skills. Table C.2. highlights that the distribution of total counts per choice category was not significantly different and the p-value is quite large, indicating no significant difference between Group 4 and other groups.

Table C.2
Survey 2 novel-constructs - No significant difference between Group 4 and other Groups

Concept	Survey Value	Group 2,3 N=	Group 4 N=	p-value (ignoring NA's), using the Wilcoxon Rank Test between Groups 2 & 3 collectively and Group 4
Cognitive Bias	5	75	37	0.06211
	4	95	60	
	3	28	21	
	2	8	10	
	1	2	2	
	NA	2	3	
Psychological Safety	5	76	47	0.2591
	4	94	46	
	3	24	23	
	2	12	12	
	1	2	2	
	NA	2	3	
Interpersonal Communication	5	88	50	0.1369
	4	94	51	
	3	18	22	
	2	7	5	
	1	1	2	
	NA	2	3	

The imperative to measure the potential impact of bias on survey results is rooted in the need to ensure the reliability and validity of the data obtained. Concerns

such as social desirability bias, expectation bias, and recency bias pose risks to the authenticity of respondents' answers, potentially distorting the representation of their true perceptions. Upon scrutiny of the data delineated in Tables C.1. and C.2., it can be deduced with reasonable certainty that the presence of bias did not exert a significant effect on the survey outcomes. This discovery is important because it confirms the methodological validity of combining the dataset from Group 4 with those of Groups 2 and 3 for further analysis.

Appendix D - Interview Guide

Reference 5.5.2

Enhancing CRM/TEM: Interview Protocol

Before the interview
[Be sure they saw the Google Doc. Create a folder in Google Drive IPH800 folder with the participant number and name. Within this, create another folder called Materials.]

Before we start, I want to ask you if it's okay to record the audio portion of this interview, so I don't have to take notes throughout? I do this so I can re-listen to the answers later on, which allows me to be more present in the actual interview rather than heads down writing. Your name will not be shared with anyone at [redacted for anonymity] or in any of my academic work. I will keep your answers anonymous.

[If they are willing to allow me to record, start transcription app] Thank you!

Question Section 1: Background

1. You attended the Standards Meeting, so beyond a pilot, what is your role at the company? *[Captain, Instructor, Line Check Pilot, Evaluator]*
2. Okay, so let's rewind a bit.. going back to your early flying days, where did you learn to fly - was it a Part 141 school, FBO, military?
    a. Where did you get your ATP?
    b. What was the CRM training like there?

Question Section 2: Psychological Safety

1. During the fall standards meeting, I did a presentation about enhancing CRM and talked about the concept of psychological safety. I defined the concept as *[give definition].* Do you think that concept is relevant to good CRM? Why or why not?
2. Can you share a story of when you experienced low psychological safety on the flight deck and how did that impact CRM/TEM?
    a. What about SOP compliance – any impact there?
    b. Were you an FO or a CA?
    c. What behavior from your crewmember caused the condition?
    d. What was your reaction/behavior?
    e. How did you display low psychological safety?
3. Now can you think of a time when you were *[Use the opposite of CA/FO from the answer in Q6]* when you experienced low psychological safety?
    a. How did you display low psychological safety?
    b. Was your behavior different from the previous example? If so, why?

Question Section 3: Behavior

1. As a *[CA, LCA, E, I based on Q1]* what behaviors do you think reduce psychological safety in the flight deck for the other pilot?
2. What behaviors increase psychological safety?

3. When you were a First Officer, what were some of the traits and characteristics of what made a bad Captain? Sometimes we learn from "bad" Captains, what did you want to make sure you avoided in terms of setting the tone with the crew?
4. How do people react when they show up and find out that clearly they're crewed with a pilot that has dramatically different political, religious, social, generational views?
    a. How do you feel when someone is overtly displaying a political or social aspect that is counter to your views?
    b. Would it help if you had known something about them before meeting just before a flight? If so, why would that be helpful?

Question Section 4: Resiliency & Competency

Okay, I have just a few more questions here and then I'll wrap it up.

1. What does *resilience* or having *resiliency* mean to you?
    a. What is the role of personal or individual resilience in the ability to build psychological safety in the flight deck microculture?
2. If pilots were trained on building psychological safety as part of advanced CRM, how should we measure a pilot's competency?
3. You can probably tell that I'm really interested in crew dynamics and how collaboration impacts safety. In that regard, what question did I not ask that I should have? *[Prompt: what else is relevant to getting pilots to work together - to build psychological safety?]*
4. Is there anything else that you'd like to share?

Question Section 5: Conclusion

1. I'd like to record *gender* and *race* and whether you're a *captain vs. first officer.* For the purpose of the transcript, would you please share those three pieces of demographic details with me?
2. Do you have any questions for me?

That's all of my questions. Thank you for your time!

[Stop recording]

Appendix E - Expanded Methods & Results for Research Questions 1 & 2

Reference 6.2

E.1 Research Question 1

RQ1: Have industry safety leaders been trained on the FAA-recommended interpersonal skills?

As this research question was confirmatory, the complementary hypothesis is as follows: H1: Safety leaders have a higher level of training on FAA-recommended interpersonal skills than the general population of pilots.

To test Hypothesis 1, I utilized Crew Resource Management (CRM) principles outlined in FAA Advisory Circular (AC) 120-51E, as detailed in Perkins, Ghosh, Hall (2024), "Interpersonal Skills in a Sociotechnical System: A Training Gap in Flight Decks." This study serves as a comparative benchmark, considering data from airline, charter, and corporate pilots alongside Pilot Safety Leaders (PSLs) to assess FAA-recommended CRM training.

Using Survey 1 responses, I compared PSLs' recall of CRM training against the broader pilot population's perceptions. Results are detailed in Table E.1.a, which shows n values for each training concept. Table E.1.b compares PSLs against other groups of pilots indicating that PSLs consistently reported higher training levels across various interpersonal skills, supporting Hypothesis 1.

Table E.1.a

Groups 1- 4, Survey 1, Question 5 results

FAA-recommended CRM training concept	Total n=599	Percentage %
Communication	588	98.16%
The importance of clear and unambiguous communication	540	90.15%
Speaking skills	344	57.43%
Listening skills	466	77.80%
Interpersonal relationships and practices	414	69.12%
The influence of biases on decision quality	467	77.96%
The influence of cognitive factors on decision quality	403	67.28%
Strategies to handle conflict	452	75.46%
External influences on interpersonal communications	413	68.95%
Ways to behave to foster crew effectiveness	455	75.96%
Remaining calm under stressful conditions	443	73.96%

Definitions of and/or solutions for interpersonal communication barriers such as rank, age, and gender	413	68.95%
The value in maintaining a friendly environment	415	69.28%
Effective team behaviors during normal and routine operations	455	75.96%

Table E.1.b
Results of RQ1 comparing three categories of pilots on their recall of training on FAA-recommended CRM concepts

Interpersonal Skill	CRM Training Curriculum Concepts	Aggregate	Part 121 General	Safety Leaders Part 121
Interpersonal communication	Communication	93.90%	94.40%	98.16%
	The importance of clear and unambiguous communication	85.90%	84.90%	90.15%
	Speaking Skills	51.00%	49.70%	57.43%
	Listening Skills	63.60%	66.10%	77.80%
	Interpersonal relationships and practices	54.00%	56.60%	69.12%
	External influences on interpersonal communications	48.00%	46.30%	68.95%
Bias Literacy	The influence of biases on decision quality	53.00%	56.60%	77.96%
	The influence of cognitive factors on decision quality	51.00%	56.60%	67.28%
	Definitions of and/or solutions for interpersonal communication barriers such as rank, age, and gender	47.40%	48.90%	68.95%
Psychological Safety	Strategies to handle conflict	56.90%	57.70%	75.46%
	Ways to behave to foster crew effectiveness	55.20%	59.00%	75.96%
	Remaining calm under stressful conditions	56.00%	51.60%	73.96%
	The value in maintaining a friendly environment	48.10%	48.40%	69.28%
	Effective team behaviors during normal and routine operations	66.70%	67.50%	75.96%

This finding holds significant implications: it suggests that Pilot Safety Leaders (PSLs) possess a heightened awareness and recollection of Crew Resource Management (CRM) training, specifically in the domain of interpersonal skills, as recommended by the Federal Aviation Administration (FAA). The increased recall rate among PSLs, in contrast to the general pilot population and the subgroup of airline pilots, lends partial empirical support to Hypothesis 1.

E.1.1 Training on the FAA-recommended CRM concept sensitivity

Additional analysis was conducted on the FAA-recommended CRM interpersonal skill *sensitivity*. As previously established, the FAA AC 120-51E references "sensitivity" in two distinct ways. It recommends CRM training curriculum include subtopics such as, "demonstrating the usefulness of showing sensitivity to other crewmembers' personalities and styles" (pg. 11), and it recommends utilizing behavioral markers as indications of good CRM, which include, "crew members show sensitivity and ability to adapt to the personalities of others" (pg. 4) (Federal Aviation Administration, 2004).

In order to determine whether safety leaders perceive themselves to have been previously trained on sensitivity as part of previous CRM training, Survey 1, Question 6 asked all respondents: "When being evaluated on CRM skills, must you demonstrate your understanding of the usefulness of showing sensitivity to other crew members' personalities and styles?" As with all survey questions, responses were optional. For this particular question, the choice was binary, either "yes" or "no".

One-hundred seventy-eight (N=178) opted out of answering S1_Q6. Of the remaining respondents (N=666) who opted to answer this question, 77% (N=513) selected "yes" and 23% (N=153) selected "no".

I then compared these results against those of the general pilot population as published in "Interpersonal Skills in a Sociotechnical System: A Training Gap in Flight Decks".

Table E.1.1 demonstrates that the cohort of Pilot Safety Leaders (PSLs) reports a more extensive level of training in the interpersonal skill of sensitivity, as recommended by the FAA, compared to the general pilot population.

Table E.1.1

Training Topic: Demonstrate your understanding of the usefulness of showing sensitivity to other crew members' personalities and styles.

Q. When being evaluated on CRM skills, must you demonstrate your understanding of the usefulness of showing sensitivity to other crew members' personalities and styles?				
	Pilot Safety Leaders		General Industry Pilots	
	Yes	No	Yes	No
N value	513	153	397	413
Percentage	77%	23%	49%	51%

A considerable seventy-seven percent of the Pilot Safety Leader (PSL) group affirmed receiving training in Crew Resource Management (CRM) that encompassed the importance of exhibiting sensitivity, in stark contrast to a mere forty-nine percent of the general industry pilot population. This significant difference further supports Hypothesis 1.

E.1.2 Summary of RQ1

This research question aimed to assess whether Pilot Safety Leaders (PSLs) receive more extensive training in FAA-recommended interpersonal skills compared to the general pilot population. Results showed that PSLs consistently reported higher

training levels across various CRM facets, particularly in the need to demonstrate sensitivity toward other crewmembers. Collectively, these findings support Hypothesis 1, which positions PSLs as Subject Matter Experts in CRM relative to the general pilot population.

E.2 Research Question 2

RQ2: Do industry safety leaders believe that FAA-recommended interpersonal skills are important for safety?

As this research question was confirmatory, the complementary hypothesis is as follows: H2: Industry safety leaders, in general, believe that FAA-recommended interpersonal skills are important for safety.

My primary research inquiries necessitated a deeper comprehension of the subjects under study, namely the Pilot Safety Leaders. Therefore, hypothesis 1 testing established that the PSLs received advanced CRM training relative to the general pilot population. While this provides insight into cognitive processes (e.g., whether they recall the concepts from training), it does little to measure their affective processing (e.g., sentiment and attitude toward the relevancy of interpersonal skills as a necessary component to aviation safety). The composition of RQ2 was established to fill this gap. RQ2 aims to glean insight into PSLs' perceived value of FAA-recommended interpersonal skills as part and parcel of CRM and, thus, aviation safety. To test H2, two distinct analyses were conducted utilizing various survey questions.

E.2.1 Pilot Safety Leaders' Perceived Level of Importance in Showing Sensitivity for Enhanced Safety

Survey 1, Question 7 asked PSLs, "In your opinion, would safety be enhanced if pilots were required to demonstrate sensitivity toward other crew members' personalities and thinking styles?" This question was asked immediately after Q6, which was examined in the previous subsection.

As with Survey 1, Question 6, the response was voluntary, and the choices were the binary options of "yes" or "no". A total of 497 PSL responded to Question 7. Sixty-seven percent (N=334) responded "yes" while 33% (N=163) responded "no".

Table E.2.1
All Groups, demonstrating sensitivity as a method to enhance safety.

In your opinion, would safety be enhanced if pilots were required to demonstrate sensitivity toward other crew members' personalities and thinking styles?"			
	Yes	No	Total
N value	334	163	497
Percentage	67%	33%	100%

The analysis reveals a significant majority of Pilot Safety Leaders (67%) acknowledge the connection between the exhibition of sensitivity in interpersonal dynamics and the improvement of safety measures within aviation operations. This recognition by PSLs implies an understanding that the interpersonal skill of sensitivity is not merely a beneficial attribute but a critical component that potentially contributes to the enhancement of safety protocols and outcomes. Conversely, a smaller proportion of PSLs (33%) do not recognize this link, which may reflect variations in training emphasis or personal perceptions of the role of interpersonal skills in safety practices. The findings underscore the prevailing view among PSLs that interpersonal skills, such as sensitivity, are integrally linked to the operational efficacy and safety within the flight deck, thus supporting the necessity for comprehensive CRM training that includes interpersonal skill development.

E.2.1.1 Deepening the Analysis of Sensitivity

As delineated in the Federal Aviation Administration's Advisory Circular on Crew Resource Management Training, the notion of "sensitivity" is referenced on two separate occasions, signifying its pertinence. Yet, the significance of this concept extends beyond its mere lexical definition. In subsequent chapters, we shall delve into the nuanced interplay between interpersonal communication and the establishment of psychological safety, both of which are intricately connected to the capacity for demonstrating sensitivity to the diverse personalities and cognitive styles of others. Consequently, it warrants a rigorous inquiry into the multifaceted rationales underlying the perspective of the one-third minority of this cohort, proficient in CRM, who seemingly undervalue this particular concept.

Step one of this analysis was to filter pilots who responded to both Survey 1, Questions 6 and 7 (e.g., S1_Q6 and S1_Q7). This filtering allowed analysis of the pilots who recalled receiving CRM training on the concept of sensitivity (Q6) relative to those who perceived there was a correlation between sensitivity and safety (Q7).

Table E.2.1.1 shows the comparison of those who recall having or having not received CRM training highlighting sensitivity and their outlook on the importance of the concept relative to safety.

Table E.2.1.1
Training Sensitivity Increases the Sentiment toward the Construct

	Sensitivity = pro-safety		Sensitivity ≠ pro-safety	
	N value	percentage	N value	percentage
Received Training Total N=379	294	78%	85	22%
Did not Receive Training Total N=118	40	34%	78	66%

Pilot Safety Leaders who have reported to have undergone training are twice as likely to acknowledge a positive association between sensitivity and enhanced safety compared to their untrained counterparts. Moreover, individuals lacking such training

are thrice as likely to refute the existence of the connection between demonstrating sensitivity and safety. This phenomenon suggests that the recognition and internalization of a concept by Pilot Safety Leaders (PSLs) are significantly swayed by their recollection of having received formal instruction in Crew Resource Management (CRM) concerning the concept. In essence, the capacity to recollect a training concept exerts a profound influence on one's emotional engagement with the concept. This, sequentially, affects the endorsement of and the attitude towards the concept's utility and relevance in the context of flight deck safety models and systems.

E.2.2 Evaluation of Pilot Safety Leaders' Perceived Significance of the Interpersonal Skills Endorsed by the Federal Aviation Administration

To measure whether PSLs found value in the FAA-recommended interpersonal skills, I analyzed the aggregate responses to the following questions from Survey 1, Groups 1-4 from Data Level 1:

How important are the following concepts to enhancing safety?

- "Ability to adapt one's personal leadership style" (see FAA, 2004, Appendix 1, Section 2.b.2) (henceforth labeled *Adapt*).
- "Emphasizing the value of maintaining a friendly, relaxed, and supportive yet task-oriented tone" (see FAA, 2004, pp. 11, Section 12.b.2) (henceforth labeled *Tone*).
- "Showing sensitivity to other crew members' personalities and styles" (see FAA, 2004, pp. 11, Section 12.b.2) (henceforth labeled *Sensitivity*).

Table E.2.2 delineates the categorization of FAA-endorsed interpersonal skills alongside the articulated valuation of each by the Pilot Safety Leaders.

Table E.2.2
Pilot Safety Leaders' Perceived Level of Importance for FAA-Endorsed Interpersonal Skills

Level of Importance	FAA: Adapt		FAA: Tone		FAA: Sensitivity	
	N value	%	N value	%	N value	%
Extremely important	151	24.8%	233	38.2%	68	11.2%
Very important	263	43.2%	272	44.6%	192	31.6%
Moderately important	147	24.1%	85	13.9%	217	35.8%
Slightly important	41	6.7%	16	2.6%	99	16.3%
Not at all important	6	1.0%	4	0.7%	26	4.3%
I don't know what this means	1	0.2%	0	0%	5	0.8%
Total	609	100%	610	100%	607	100%

Sixty-eight percent of PSLs (N= 414) believe the ability to adapt one's personal leadership style is very or extremely important. Similarly, 82.8% (N=505) believe that tone is very or extremely important. In contrast, only 42.8% (N=260) feel that the construct of sensitivity is either very or extremely important. When we expand the analysis of the importance and include the value of "moderately important", we see that the majority of PSLs believe these constructs are important to enhancing safety.

E.2.3 Summary of RQ2

The research in this section looks into how Pilot Safety Leaders (PSLs) view the importance of FAA-recommended interpersonal skills, as proposed by Hypothesis 2 (H2). It's empirically analyzed through a set of survey questions aimed at understanding PSLs' perception of the value of each skill.

The data indicates a strong majority of PSLs (67%) affirm the positive impact of sensitivity on safety, which illuminates the criticality of this skill in fostering safe flight operations. Furthermore, the investigation into the PSLs' ability to recall training on sensitivity reveals that those who remember such training are more inclined to perceive a correlation between sensitivity and safety. This underscores the influence that recollection of formal training has on PSLs' affective processing and their endorsement of the utility and applicability of interpersonal skills within the flight deck.

A deeper analysis of the importance PSLs place on various interpersonal skills—such as adaptability, tone, and sensitivity—shows that a majority consider these skills as ranging from moderately to extremely important for safety. Specifically, 92% attribute high importance to adaptability, 97% to tone, and 79% to sensitivity.

These findings have profound implications for the progression of this research, particularly as it explores advanced interpersonal skills. They not only support H2 but also emphasize the perceived significance of interpersonal skills among PSLs, which is crucial as these leaders play a pivotal role in maintaining and enhancing safety on the flight deck. The confirmation of H2 suggests a broad consensus among PSLs on the importance of FAA-endorsed interpersonal skills, which reinforces the relevance of incorporating these skills into CRM training and further validates the finding that PSLs are CRM subject matter experts.

Appendix F - Expanded Methods & Results for Research Questions 3 - 5

F.1 Expanded Analysis for RQ3 & 4

Reference 6.3

The following subsection uses research conducted in collaboration with Kenny Zhang, a PhD student in statistics at the University of Washington, during the Spring Quarter of 2023.

To measure whether the advanced interpersonal skills were 1) understood by PSLs and 2) perceived as valuable for enhancing safety, I designed an exploratory research question, which is reflected in RQ3. This research question serves as a necessary function to measure the baseline understanding and endorsement of the three advanced concepts' relevance to CRM before conducting a lecture-based training intervention.

Survey 1, Question 8 asked the PSLs the level of importance they gave to the three advanced concepts designed to be introduced during the intervention. A five-point Likert scale was used.

Similarly to the previous subsection, I analyzed the aggregate responses from Survey 1, Groups 1-4 from Data Level 1. Table F.1.a shows the breakdown of the three advanced interpersonal skills and PSLs' stated level of importance for each prior to the lecture-based training intervention.

Table F.1.a
Survey 1, Question 8: "How important are the following concepts to enhancing safety?

Level of Importance	CB*		PS*		IC*	
	Total N	%	Total N	%	Total N	%
Extremely important	97	21.2%	45	9.8%	146	32.0%
Very important	175	38.3%	102	22.3%	202	44.3%
Moderately important	109	23.8%	146	32.0%	82	18.0%
Slightly important	46	10.1%	85	18.6%	21	4.6%
Not at all important	11	2.4%	24	5.3%	4	0.9%
I don't know what this means	19	4.2%	55	12.0%	1	0.2%
Total	457	100%	457	100%	456	100%

*Table note:
CB = Raising awareness of cognitive biases.

PS= Understanding ways to create psychological safety.
IC= Tools for improving interpersonal communication.

Another insight into the PSLs' view of advanced interpersonal skills relative to improved safety is through the framework of enhancing CRM. Survey 1, Question 12 was a matrix which asked participants, "In your experience of operating in a crew environment, would training pilots on _____ enhance safety through improved Crew Resource Management (CRM)?" The fill-in-the-blank options were 1) cognitive biases, 2) psychological safety, and 3) interpersonal communication skills.

Table F.1.b provides the breakdown of the matrix with both N-value and percentages.

Table F.1.b
Survey 1, Question 12: "In your experience of operating in a crew environment, would training pilots on _____ enhance safety through improved Crew Resource Management (CRM)?"

	CB*		PS*		IC*	
Response	Total N	%	Total N	%	Total N	%
Definitely yes	159	33%	88	18%	254	53%
Probably yes	189	40%	155	33%	175	37%
Might or might not	79	17%	105	22%	39	8%
Probably not	21	4%	37	8%	4	1%
Definitely not	9	2%	13	3%	2	0.5%
I don't know what this means	21	4%	78	16%	2	0.5%

*Table note:
CB = cognitive biases, PS= psychological safety, IC= interpersonal communication

Psychological safety elicits the largest percentage of respondents selecting "I don't know what this means". Percentagewise, nearly as many people are selecting the "definitely yes" option (18%) as those stating they don't know what it means (16%). These results indicate that the construct of psychological safety is more ambiguous (in general terms) for the PSLs; thus, there is a lower acceptance of its

importance and its relevance for enhancing Crew Resource Management prior to a lecture-based intervention. It should be noted that the analyses presented herein are descriptive in nature, focusing on qualitative comparisons rather than drawing statistical conclusions.

F.2 Wilcoxon Signed Rank Test

Reference 6.3.1

Analyzing changes between pre-intervention and post-intervention survey data was the focus of our collaboration. Survey 1, Question 8 was identical to Survey 2, Question 1.

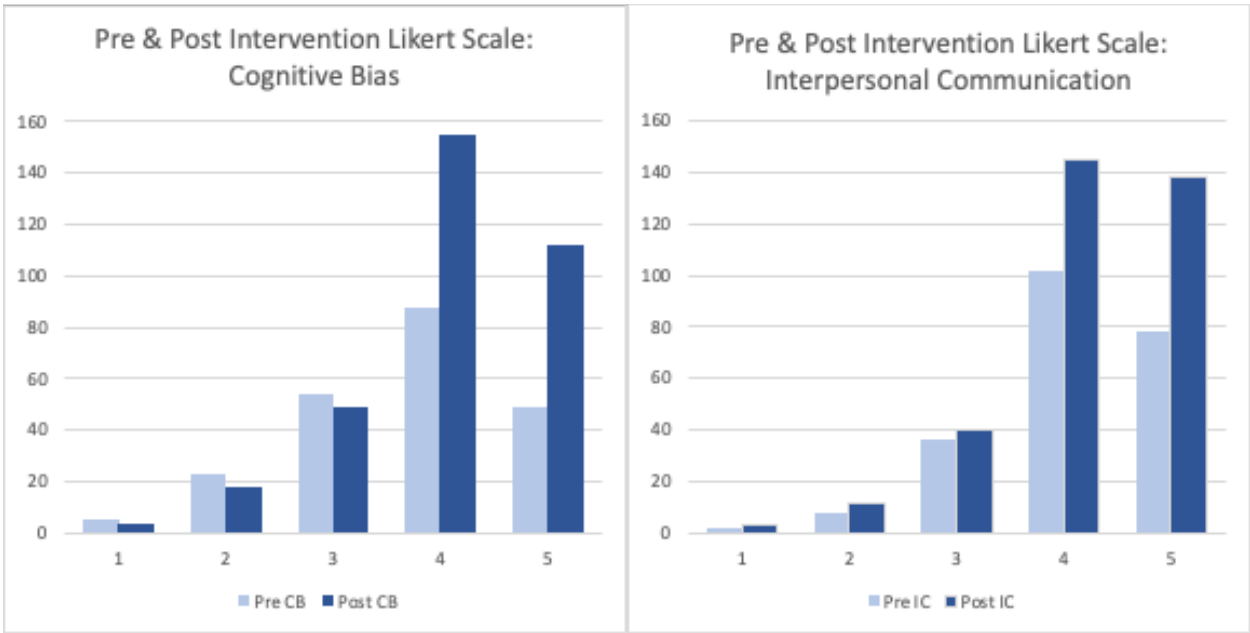
The question consisted of a matrix asking respondents to rate the level of importance of six interpersonal skills constructs (three FAA-recommended and three novel) with the option to select *I don't know what this means.* Likert scale responses were converted to a numerical value as follows:

5 = Extremely important
4 = Very important
3 = Moderately important
2 = Slightly important
1 = Not at all important

Using the unique codes captured in all surveys, I was able to link individual PSL responses from both surveys. As the distribution is non-parametric, a Wilcoxon signed rank test was utilized for hypothesis testing. The results of this test are found in section 6.3.1 of this dissertation. Interpersonal communication had a higher p-value than the other constructs, which required that I return to the data for further analysis.

Figure F.2 offers a bar graph comparison of the Likert-scale distribution of responses pre- and post-intervention for interpersonal communication ("IC", right panel) compared to changes in cognitive bias ("CB", left panel). This comparison highlights that there was a higher level of endorsement (represented by a large value on the Likert scale) for interpersonal communication than cognitive bias prior to the invention. That is to say that before the training, PSLs already had a high level of endorsement for interpersonal communication skills, so the opportunity for improvement was smaller.

Figure F.2
Comparison of IC and CB before and after the Intervention



By maintaining consistency in questioning across both surveys, the research provides a robust mechanism for measuring the shift in perceived importance among Pilot Safety Leaders (PSLs) regarding six interpersonal skills constructs.

The adaptation of a Likert scale to quantitative values affords a precise, numerically based analysis of respondents' attitudes, with the Wilcoxon signed rank test offering an appropriate non-parametric method for assessing the median of paired differences given the data's distribution.

The very low p-values documented in Table 6.3.1 categorically suggest that the null hypothesis can be confidently rejected. This rejection implies a statistically significant positive shift in PSLs' endorsement of interpersonal skills due to the intervention, an outcome that underpins the efficacy of the training provided.

This nuanced understanding is crucial as it indicates the pre-intervention competence level of PSLs in certain constructs and how that influences the potential impact of the intervention.

In essence, the statistical significance found in these results underscores the positive transformation in PSLs' stated valuation of interpersonal skills following the intervention, which reinforces the premise that targeted training can effectively enhance SMEs' acknowledgment of these skills' importance in enhancing safety through improved Crew Resource Management.

F.3 Expanded Thematic Analysis

F.3.1 Themes of Content to Leave Out of Future Training

Reference 6.3.2.2

Table F.3.1
Eleven themes for Survey 2, Question A

Theme	N-value	Examples from Data	
It was good	40	None. This training was absolutely fantastic and I want to learn more. Nice job keeping it concise and less academic. None, this was all very fascinating. I love how much our industry continues to deep dive and evolve our understanding and impact of CRM to safety.	I think the areas covered are very important. Especially as we are hiring the numbers that are being forecast. Great material. Thank you for being here and sharing your information. None. Given the scope and time allowed, the presentation was excellent Excellent job Not sure at this point but I'm interested in learning more.
Specifically referencing one of the advanced interpersonal skills	7	Some of the brain location stuff. But not critical. Brain diagram & labels. Psychological Safety	Remove psychological safety and use trust. Bias Interpersonal communication
Comment on the training: Do less of a recap from Day 1	4	Repetition of data charts	Less recap from previous day would allow more time for discussion
Comment on the training: Too long or too rushed	6	It was very rushed. Needs to be shorter	Hard to capture all human factors concepts in a 1 hr brief

Comment on the training: Too complicated	13	Theoretical stuff lost the audience Very academic and busy slides To many complex slides and too much information	Some of the background information about the research was a bit too technical. Some of the slides were too complex for us to understand in short order. Data driven slides on soft skills is difficult for me to relate to
Dislike: overt anger	8	All of it. Todays social culture warfare in America	Don't bring this back. Don't burden people with your problems because you can.
Dislike for a discussion on power	6	Your personal opinion about "who are these 15% that answered no" impacted my physiological safety, and threatened to make me just stop listening at point.	Bias toward a perceived power group Institutional power
Dislike for a discussion on demographics	4	The initial focus of some data of breaking barriers to women in aviation can be off putting to people. I do not agree with this. But what I'm saying is that I heard a lot of grumbling about this. Right or wrong, it could help with getting people to pay attention. Thank you for considering this.	The fact that pilots are 95 percent white male. All race gender ethnicity terms…
Dislike for a discussion that felt too sensitive	3	Some of the sensitivity issues should be left out…just like conversations about politics and religion	The Captain and FO uncomfortable scenarios How to train FOs to deal with 1/1 Captain to include getting off the trip.

Don't change anything	255	Not sure I'm new to some of these concepts. No	None Nope
Other	13	Time management and stressors Some of outside references Intentional noncompliance	Professional mindset Behavior styles … DISC Could this all be avoided with a single pilot flight deck

The majority of respondents (82.2%, N=295) either recommended not changing anything (theme: *don't change anything*) or went so far as to write in their approval (theme: *it was good*). Six percent (6.4%, N=23) commented on the presentation itself, stating it was either too long, too complicated, or too repetitive from the previous day. Another 5.9% (N=21) did not like the presentation in total (N=8) or disliked a facet of the presentation, such as the mention of demographics, power, or concepts they deem "sensitive." The remaining responses either commented directly on one of the three advanced interpersonal skills (1.9%, N=7) or referenced concepts that the intervention did not cover, which I labeled *other*, (3.6%, N=13).

F.3.2 Themes of the Most Useful Concept of Training

Reference 6.3.2.3

As with the previous question, a thematic analysis was conducted. Across Groups 2-4, the question received a total of 581 responses. All data was coded through an iterative process where fourteen themes emerged. Table F.3.2 shows the themes, the total n value for each theme, and representative examples of the theme utilizing direct quotes.

Ninety-three respondents (16%) wrote responses suggesting that awareness and a growth mindset were the most important concepts from the training. Self-awareness and adopting a growth mindset were important elements of the training offered as counter-measurement tools to the negative effects of the bias triad. Sixty-nine respondents (11.9%) believed training applied to enhancing safety through improved CRM. All of these responses were useful; however, I was interested in determining the number of respondents who specifically chose one or more of the advanced interpersonal skills as the most useful training concept. To do this, I examined the frequency of write-ins for the following themes: *all of it* (N=4), *interpersonal skills* (N=9), *interpersonal communication* (N=55), *bias* (N152), and *psychological safety* (N=84). A total of 304 PSLs (52.3%) specifically selected one or more of the advanced interpersonal skills concepts. A few of the peripheral or secondary training concepts

emerged within the themes, such as the discussion of *power* (N=10), *generational* expectations (N=5), and *safety voice* (N=9).

Table F.3.2
Fourteen themes for Survey 2, Question B

Theme	N-value	Examples from Data	
Bias	152	The reminder of our biases and assumptions is a daily struggle. This additional training will only enhance our safety culture. Thank you for making this available. Good presentation using brain physiology to help interpret The Why and how	The confirmation bias portion was awesome and spot on, excellent presenting. Naive realism and how it can cause fundamental attribution errors and build internal walls.
Psychological Safety	84	Defining the terms is helpful since I didn't know what those terms meant. Psychological safety is probably most critical in my view as it creates or inhibits an open communication environment. This is the first time I have heard the concept of "physiological safety", which until now I have thought of as shutting down. I have done this and I've seen others do it and understanding the link between it and the flight/fight response was very informative.	I had not heard the term "psychological safety". I love this term and will use that to expand my use of the other concepts presented. Excellent brief on psychological safety and tying that in to CRM/TEM

Interpersonal Communication	55	Being open to learning about different styles of communication and reception of these communications.	Improving communication to enhance safety and cooperation.
Growth Mindset/ Awareness	93	Growth mindset. The vast majority of people have the capacity to understand another's mindset if they allow themselves to try. Understanding their are barriers that need to be addressed personally and company wide. Dialogue has to be attempted.	Growth mindset. Understanding how the different biases affect the flight deck environment is extremely useful. The idea of setting the tone and looking at the other individuals perspective
All of it	4	It was all relevant.	I felt it was all important
Interpersonal Skills	9	Interpersonal relationships	Interpersonal skills
Power	10	Recognizing the power position I hold as an LCA and how that could create a blind spot in any bias I may not recognize.	Bringing awareness to the fact that power itself can be a silencer.
Generational	5	The biases that long time pilots might have. Also, as the demographics change in the workforce this will be more important.	The discussion of how we communicate with our younger pilots. Realizing that I need a growth mindset working with millennial pilots.
Safety Voice	9	Importance of safety voice and listening	The concept of safety voice vs safety silence.
Applicability	69	It opened my eyes to many more concepts and options that I can use during my job to improve safety	Understanding that our environment is changing, and adaptation to it is important to running a safe flight deck.

		PIC must adapt their leadership style, vs FOs are traditionally considered the chameleon Fantastic details about our complicated human characteristics. Really got me thinking about how we mis-perceive things and have a tendency to react based on our inward feelings.	Proof of flight deck tone enhancing or diminishing safety in the flight deck. Psychological safety training. I think this is huge in helping captains create a safe environment. More in person CRM training is always more beneficial than the current training by CBT's so I that respect, the training is useful.
Comment directly on the lecture	42	Complex concepts presented simply. Easily digestible. Excellent presentation made a potentially difficult topic eas[y] to digest The putting it all together slide and discussion using the day two crew van scenario - really tied it all together.	I can't single out one area. I did enjoy the presentation. Extremely important concepts for safety all crew interpersonal communication. It was all outstanding, seriously. Well presented and informative. Excellent presentation on new concepts.. great job
Unsure of Intent	15	That I am Bias Didn't realize this was training. Seems like this is just building on societal norms that everyone is special. Some very good points were presented.	That white males are being forced to listen to it. Advancing the concept of psychological comfort. it's really not safety as we are not talking about domestic abuse environments. We seem to be overusing the term safety.
Overt Anger	11	Learning to read the room. Just don't launch a pretentious subject. I don't need to know it.	None Not useful information

Other	27	It puts a name to many common sense things we already do as introspective pilots… Using actual situations to make the points	Realizing there is a possible problem looming. Don't be judgmental

F.4 Expanded Comparative Analysis of Sentiment Pre- and Post-Intervention

Reference 6.3.3

I compared the comments from Survey 1, made before the training, to the comments from Survey 2, made immediately after the training.

For Survey 1, I utilized the following question for the sentiment analysis: “Reflecting on your previous answer, why do or don't you believe safety would be improved by training pilots on 1) cognitive biases, 2) psychological safety, and 3) interpersonal communication?”

In the analytical approach to Survey 2, I consciously eschewed the question framed positively to mitigate any potential bias in sentiment analysis. Instead, I chose to examine the formulated question in a negative construct, thus opting the most judicious approach to evaluate sentiment. This strategy ensured that any expression of negative sentiment could emerge unimpeded by the question’s design. Consequently, any observed amplification of positive sentiment or diminishment of negative sentiment can be more confidently attributed to the impact of the intervention rather than the influence of the question's phrasing. For Survey 2, I utilized the question below for sentiment analysis:

If any, which aspects or concepts could have been left out of the training?

Before coding for sentiment, I established these terms and definitions:

Positive: Acknowledging the relevance of interpersonal skills to enhancing safety

Neutral: Neither positive nor negative; commentary

Negative: Overt anger, annoyance, gaslighting (Sweet, 2019), and/or belittling the relevance of interpersonal skills to enhancing safety

Before the intervention, 23.3% of PSLs showed a positive sentiment toward interpersonal skills, whereas post-training a total of 82.2% of PSLs indicated positive sentiment. Therefore, positive sentiment increased by 252.8% ((82.2 - 23.3)/23.3 * 100) post-training while negative sentiment decreased slightly by 15.5% ((14.2-16.8)/16.8 *100).

Table F.4
Sentiment Analysis of *Survey 1 vs. Survey 2 Questions*

Survey Question	Survey	Total N	Negative	Neutral	Positive
Reflecting on your previous answer, why do or don't you believe safety would be improved by training pilots on 1) cognitive biases, 2) psychological safety, and 3) interpersonal communication?	1	304	16.8%	59.9%	23.3%
If any, which aspects or concepts could have been left out of the training?	2	359	14.2%	3.6%	82.2%

The comparison of comments from Survey 1 to Survey 2 is significant as it provides empirical data on the sentiment shift among Pilot Safety Leaders (PSLs) regarding the impact of training on cognitive biases, psychological safety, and interpersonal communication. The decision to refrain from sentiment analysis on Survey 2, Question B, is based on the need to avoid bias introduced by the question's positive phrasing. Instead, the focus on Question A's negative framing allowed for an unguided and potentially candid expression of any negative sentiments, offering a more balanced and genuine measure of PSLs' attitudes.

The sentiment analysis before and after the intervention revealed a remarkable increase in positive sentiment towards interpersonal skills—from 23.3% to 82.2%—indicating a substantial shift in perception due to the training. This suggests that the training successfully trained the importance of these skills in enhancing aviation safety, as reflected by the decrease in negative sentiment post-intervention. Such data is critical for validating the effectiveness of the training and for informing future educational strategies to further align with PSLs' professional development needs.

F.5. Expanded Analysis for RQ5

Reference 6.4

This research question is confirmatory; thus, a complimentary hypothesis must be offered.

> H4. Non-prototype pilots will have a higher level of endorsement of FAA and advanced interpersonal skills training *before* the intervention.

The research has corroborated that Pilot Safety Leaders (PSLs) are a cohort with substantial expertise and extensive training, typically demonstrating strong advocacy for interpersonal skills subsequent to their training. Recognizing this group as exemplars within their field, it was deemed imperative to explore the influence of marginalized statuses on the valuation of interpersonal skills. Acknowledging that all pilots receive training in FAA-specified interpersonal competencies, this discourse concentrates on the trio of advanced interpersonal skills introduced during the intervention training.

Th following analysis will reference the findings related to FAA-specific skills to provide context; however, the primary emphasis will pivot toward the implications and perceptions surrounding the advanced interpersonal skills. This focus aims to investigate how these skills might affect different demographic groups within the pilot community, especially considering the intersection of marginalization and professional development in the context of aviation safety and Crew Resource Management.

F.5.1 Results

Reference 6.4.2

White men, as a demographic group, exhibited the lowest mean endorsement across the three advanced interpersonal constructs—Cognitive Biases (CB), Psychological Safety (PS), and Interpersonal Communication (IC)—as well as the FAA-specific interpersonal constructs—Leadership Adaptability (LA), Leadership Tone (LT), and Demonstrating Sensitivity (DS).

The results and statistical analysis in the following subsection were conducted with Kenny Zhang, a statistics PhD student at the University of Washington.

To test Hypothesis 4, a series of steps were developed: 1) catalog survey responses based on demographics, 2) convert Likert-scale responses to number values, 3) calculate the mean and median for interpersonal skills questions (Survey 1, Question 8, Parts 1-6), and 4) compare values across demographic categories.

Employing the results from questions 14 and 15 of Survey 1, we were able to classify the collected responses according to demographic categories. The initial design of the survey sought to differentiate responses into six racial categories: Black or African American, White, Asian, Latinx or Hispanic, American Indian and Alaska Native, and an open write-in option for self-identification. Similarly, the survey aimed to dissect the data across four gender categories: Women, Men, Non-binary, and an open write-in option for legitimate self-described responses.

However, due to the small sample sizes (N values) within each of these specified categories, it became necessary to amalgamate the data into broader groups to facilitate a robust analysis. This reorganization was essential to ensure the statistical validity and interpretability of the findings within the constraints of the dataset.
As indicated above in Table F.5.1, there were small N values for every category except “White” and “Man”. The N values reduced further when we filtered for those who responded to demographic data and answered Survey 1, Question 8, Parts 1-6, which specifically examined interpersonal skills. To best analyze data using the tools of statistical analysis, we combined all non-White race categories into a single category and also combined “women” and “non-binary” categories into a single category. Rather than analyzing the data across nine categories (five races and four gender options), we used three categories to keep the N value high enough to run a statistical analysis on the data. The remaining categories included: 1) White Men, 2) Non-White Men, and 3) Women (which includes non-binary people).

Removing duplicates and incompletes, we were ready to analyze each of the six interpersonal skills constructs using the value scale we constructed by converting Likert

responses. We found the mean value for each demographic category across the six interpersonal skills. Using a Wilcoxon-signed rank test, the P-values were calculated. The results of the test can be found in Section 6.3.1.

Confirming Hypothesis 4, Table F.5.1 shows that non-prototype pilots (non-White men and women) have a higher mean across both the advanced and FAA-specific interpersonal skills prior to receiving a training intervention.

Table F.5.1
Endorsement for Interpersonal Skills Prior to Intervention; Prototype vs. Non-prototype Pilots

Construct	Mean			p-values	
Demographic Category	white men	women and non-binary	non-white-men	non-white-men versus white men	women versus white men
N =	341	20	34		
S1_CB	3.69	3.75	3.85	0.303	0.807
S1_PS	3.14	3.4	3.18	0.856	0.334
S1_IC	4.02	4.5	4.15	0.433	0.003
S1_LA	3.86	4.05	4.06	0.174	0.369
S1_LT	4.17	4.45	4.15	0.832	0.098
S1_DS	3.31	3.65	3.56	0.148	0.170

Note: S1 = Survey 1, CB= Cognitive Bias, PS = Psychological Safety, IC = Interpersonal Communication, LA= Leadership Adaptability, LT = Leadership Tone, DS = Demonstrating Sensitivity.

The quantitative analysis of survey data reveals a distinctive trend in the endorsement levels for both advanced and FAA-specific interpersonal skills among different demographic groups. White men, as a demographic group, exhibited the lowest mean endorsement across the three advanced interpersonal constructs—Cognitive Biases (CB), Psychological Safety (PS), and Interpersonal Communication (IC)—as well as the FAA-specific interpersonal constructs—Leadership Adaptability (LA), Leadership Tone (LT), and Demonstrating Sensitivity (DS).

Conversely, men of non-White ethnicities demonstrated the most substantial buy-in concerning cognitive biases and leadership adaptability. Women, on the other hand, manifested the highest levels of endorsement for psychological safety, interpersonal communication, leadership tone, and demonstrating sensitivity.

Prudence is exercised in the interpretation of p-values, as they are but one measure of statistical inference and do not convey the practical significance of findings. The p-values obtained in this study, while not indicative of a statistically significant

difference between the groups when adhering to conventional thresholds, nonetheless reveal a trend: women appear to place a greater emphasis on certain traits compared to White men. This trend aligns with and lends further empirical support to the confirmatory results of Hypothesis 4.

The non-significant p-values suggest that while the data does not provide strong evidence to reject the null hypothesis of no difference between groups, there is an observable variance in the valuation of the traits in question. This nuanced outcome highlights the importance of considering effect sizes and confidence intervals to fully understand the implications of the data, beyond the dichotomy of significance testing. It also underscores the need for a comprehensive analytical approach that incorporates both quantitative and qualitative data to elucidate the complexities inherent in group dynamics and valuation of interpersonal skills.

F.5.1.1 Deepening the Analysis

Reference 6.4.2.1

To explore whether the impact of the training intervention was experienced differently between prototype vs. non-prototype pilots, we used data from data level 2 (DL2). As discussed in section 5.3.4, we were able to link the responses of Survey 1, 2, and 3 to the unique individuals by using their unique code. Many PSLs did at least one survey, but few did all three. As we move through the data levels, the N values become smaller, resulting in the data becoming less reliable.

In Chapter 6, we explored responses from those who completed both Surveys 1 and 2 in order to measure the impact of the intervention. Similarly, we did this again but filtered out any data that did not contain demographic information of the respondent. This resulted in a much smaller N value than the previous analysis.

As can be seen in Table F.5.1.1.a utilizing Survey 1 and 2 data, non-prototype pilots (Women & Non-Binary) had the greatest increase of endorsement for CB, PS, LT, and DS constructs. While non-prototype pilots (Non-White Men) did have a positive increase of endorsement for all constructs except IC. The lack of a positive increase in IC could be attributed to their collective mean pre-training, which was higher than any other group, thus offering a small gap opportunity. Prototype pilots (White Men) had the largest increase in endorsement for IC and LA.

Table F.5.1.1.a
Change in Endorsement of Interpersonal Skills Constructs Across Demographic Variables Pre- and Post-Intervention

	T1			T2		
	Prototype	Non-Prototype Pilot (Non-White Men)	Non-Prototype Pilot (Women & Non-Binary)	Prototype Pilot	Non-Prototype Pilot (Non-White Men)	Non- Prototype Pilot (Women & Non-Binary)

Construct Label	N value	Mean	N value	Mean	N value	Mean	N value	Mean	% Δ T2	N value	Mean	% Δ T2	N value	Mean	% Δ T2
CB	168	3.756	14	3.643	12	3.333	259	4.077	8.55%	22	4.227	16.03%	17	4.059	21.78%
PS	150	3.26	13	3.077	11	3.091	259	4.097	25.67%	22	4.091	32.95%	17	4.235	37.01%
IC	172	4.081	9	4.4	12	4.333	259	4.224	3.50%	22	4.273	-2.89%	17	4.353	0.46%
LA	259	3.911	24	4	17	4.0589	259	4.251	8.69%	23	4.043	1.08%	17	4.294	5.79%
LT	259	4.243	24	4.435	17	4.353	259	4.421	4.20%	23	4.435	0.00%	17	4.765	9.46%
DS	259	3.375	24	3.458	17	3.471	259	4.042	19.76%	22	4	15.67%	17	4.471	28.81%

The analysis of the above table, derived from Surveys 1 and 2, indicates a notable pattern in the shift of attitudes towards the endorsement of interpersonal skills post-training. The empirical evidence suggests that both categories of non-prototype pilots—women and non-White men—exhibited a pronounced affirmation for the constructs of cognitive bias and psychological safety than prototype pilots – White men. This observation may indicate a heightened recognition among these marginalized groups of the salience of such training, potentially stemming from their distinct lived experiences and the unique challenges they navigate within the aviation industry.

Within this cohort, prototype pilots displayed a marked initial increase in endorsement for Cognitive Biases (CB), while Non-Prototype pilots exhibited the most notable initial increase for Psychological Safety (PS) and Interpersonal Communication (IC). Notably, prototype pilots were the sole group to demonstrate a sustained increase in endorsement across all three advanced interpersonal skills at T3. This denotes that the impact of the intervention for prototype pilots was maintained for CB, PS, and IC at T3. In contrast, the data indicated a diminution in the endorsement of CB among non-prototype pilots over time. Table F.5.1.1.b shows the percentage increase (or decrease) relative to a specific time (e.g., T1, T2, T3).

Table F.5.1.1.b

Temporal Effect of Interpersonal Skills Endorsement: Prototype vs. Non-Prototype Pilots

		Cognitive Bias		Psychological Safety		Interpersonal Communication		Adaptability		Tone		Sensitivity	
	N Value	% Δ T2	% Δ T3 ref T1	% Δ T2	% Δ T3 ref T1	% Δ T2	% Δ T3 ref T1	% Δ T2	% Δ T3 ref T1	% Δ T2	% Δ T3 ref T1	% Δ T2	% Δ T3 ref T1
Prototype Pilot	87	10.23%	2.34%	21.96%	6.96%	2.69%	5.96%	5.27%	2.17%	3.92%	0.3%	21.52%	7.69%

Non-Prototype Pilots	12	9.09%	-9.73%	31.77%	3.31%	11.42%	9.17%	10.02%	6.42%	11.26%	-7.55%	46.68%	17.23%

The attenuation in endorsement over the observed six to nine-month interval between T2 and T3 substantiates the recommendation to implement regular, interval-based retraining to sustain the competencies and commitments endorsed during the initial training. The strategic periodicity of such training interventions is critical to maintaining the momentum of skill application and integration within the professional practice of pilots.

This inference forms a basis for the recommendations further discussed in Chapter 9, where the frequency and structure of training regimens are deliberated to optimize the retention and practical application of interpersonal skills in aviation. This approach aligns with principles that advocate for continuous learning and the reinforcement of educational content to achieve lasting professional development outcomes.

F.6 Expanded Analysis of Conflation of Interpersonal Skills with Political Agenda and Latent Anger

Reference 6.5

To further explore how PSLs viewed the advanced interpersonal concepts, I move beyond descriptive statistics. Survey 1, Question 13 required participants to fill in the blank regarding their perception of the relevancy of the advanced interpersonal skills to enhancing safety. Immediately following the matrix question discussed in the previous subsection (see section 6.5), the subsequent question asked respondents: “Reflecting on your previous answer, why do or don't you believe safety would be improved by training pilots on 1) cognitive biases, 2) psychological safety, and 3) interpersonal communication?”

I received 304 write-in responses from Groups 1 - 4. Many of the responses were straightforward statements explaining why they agree that one or more of these constructs would improve safety. Forty-four of the responses (14.5%) were PSLs stating they did not know what either psychological safety or cognitive bias meant and, therefore, could not adequately answer the question.

Certain qualitative submissions indicated that a subset of Pilot Safety Leaders (PSLs) had already recognized the significance of one or more of the advanced interpersonal skills constructs, as evidenced by the ensuing write-in responses:

1. “Cognitive bias, if left unchecked, may lead to improper action. Interpersonal communication allows clear comm and prevents walls / emotional barriers being built whether conscious [sic] or unconsciously.”
2. “Cognitive bias training can impact on how we lead our crew members and the decisions we make. Psychological safety would improve

advocation [sic] by the crew members. Interpersonal communications would help with crew communications in the flight deck."

3. "I think that better interpersonal communication skills will lead to the psychological safety needed to speak up about safety concerns. And understanding cognitive biases will allow these concerns to be evaluated properly."
4. "Cognitive bias is a very broad term that can be interpreted in many ways. When it comes to confirmation bias, I believe it can absolutely be a threat to safety and can be improved by CRM. The other forms of cognitive bias are broader in their scope and relationship to safety. I think psychological safety is important so that someone feels safe to speak up and is an important factor in CRM. I believe interpersonal communication has decreased recently in society. It needs to be emphasized within CRM which directly affects safety."

The above quotes from four write-in responses demonstrate that these four PSLs understand and find value in the advanced concepts. These responses help substantiate the validity of the research goal of implementing the advanced concepts into future CRM training modules.

Thirty responses (9.9%) portrayed elevated negative sentiment across four major dimensions: the company's current training program, demographics (with particular negative comments toward millennials), politics (e.g., wokeness), and a lack of understanding in the concept of sociotechnical systems.

A few of the negative responses were geared toward the airline's training department, such as "This is all fluff…there is no time in any syllabus to address this…. here in the [redacted for anonymity], the syllabi are all 12 pounds of fecal matter with a 5-pound bag…."

The remaining negative sentiments were focused on demographics, both race and age as seen in the following responses:

1. "Psych safety sounds too broad and sounds like code for CRT [Critical Race Theory] ideas which I reject as destructive"
2. "Today's new hire pilots demonstrate poor work ethic, inability to focus, lack of dedication, and a shortfall of general professionalism. We can fix this but we must increase the training footprints in order to make time for additional subject area."
3. "The millennials and younger just need to do their jobs. Speak up when you don't see SOP, otherwise, sit there and be a good FO"
4. "Don't hire snowflakes."
5. "What is psychological safety? Being able to feel comfortable speaking your mind? Or is it sensitivity training for a gentler generation of pilots?"

On occasion, psychological safety was deemed "woke" or "touchy-feely" as seen in the following responses:

6. "I think it is mostly a woke term used to push social agenda versus improving flight safety."
7. "Woke agendas have no place in an aviation safety environment."

8. Psychological safety is an ill-defined term. But it reeks of ‘trigger warnings’ and ‘safe spaces’ and woke nonsense.”
9. “Everything is getting to[o] touchy-feely.”

One respondent conflated the advanced concepts with one of the company’s Diversity, Equity, and Inclusion (DEI) initiative that invites employees to identify their pronoun, as seen here: “I’m unfamiliar with cognitive bias and psychological safety. I hope it’s not pronouns.”

Another respondent agreed that both cognitive bias and interpersonal communication were important, but adamantly rejected the concept of psychological safety, as seen in the following write-in response:

> Biases…absolutely. Routinely run into various biases that impact perceptions and understandings of reality. Psychological safety….sounds like the same PC HR fluff [the company - redacted] has been pushing for a while now. We work in a demanding and unforgiving environment. Psychological safety sounds to me like code words meaning some people are so emotionally fragile that others must tread on eggshells lest they get triggered into emotional meltdowns. Pilots need thick enough skins to not be emotionally destroyed if they are corrected or run across someone with a less-than-cuddly attitude. May [sic] of us are nearly “triggered” by the ridiculous levels we’re expected to go to account for a generation of thin-skinned, emotionally stunted, spoiled, and entitled individuals. Interpersonal communication….absolutely. Communication is the main pillar of CRM. We must be able to communicate effectively for this whole thing to work.

This write-in is spot lit because of its duality. The respondent may feel strongly about the topic evidenced by their volunteerism and commitment to a lengthy response to an optional question. Yet, only a few sentences actually answer the original question. Their quick confirmation indicated that they agreed there is a link between training cognitive bias and interpersonal communication to enhance safety, but not the concept of psychological safety. The majority of their response centered on projecting their negative sentiment toward a stereotyped image of younger generations. A pronounced emotive reaction concerning individuals from the Millennial and Generation Z cohorts emerged as a recurrent motif within the data, despite the absence of direct inquiries regarding age demographics. This particular theme warrants a more detailed examination, which is undertaken in the subsequent chapters of this dissertation. Emotional engagement was palpable in some of the narrative contributions provided by the Pilot Safety Leaders (PSLs). In certain instances, mere reference to these advanced interpersonal skills provoked a semblance of a defensive rebuttal, as encapsulated in the subsequent quotation:

10. “The obvious bias that is being developed by this survey is readily apparent the [sic] survey creator is trying to evoke a mindset through these questions to support a preconceived result. All this under the guise of safety…Not at all appropriate and disingenuous.”

Other comments indicated a lack of awareness of how the advanced concepts relate to Crew Resource Management, as seen from the below responses.

11. “Take feelings out of the flight deck”

12. “The flight deck is not a democracy. I want and need input but that doesn’t always mean I’ll go with that input. Frankly, I’m tired of being told how to be a better flight deck therapist. Priority one is flying the jet.”
13. “Training pilots is very dry, bringing terms like psychological safety makes it feel like support group training.”
14. “Flying jets and working with crew members that change sometimes daily does not often afford the opportunity to do a deep dive into psychology. Bottom line is that safety doesn’t care about the psychological aspects of those manipulating the controls. It’s either safe or it isn’t.”

From these write-in responses, it is clear that some PSLs do not see the correlation between interpersonal skills and advanced safety. It may be necessary to educate them on sociotechnical systems to develop their understanding of how socio-processes impact the ability to effectively operate the technical system (in this case, the airplane).

F.7 Insights Derived from Demographic Survey Questions

Reference 6.5.1

To facilitate reader comprehension and coherence in our discourse, we have incorporated select paragraphs from section 6.5 for convenient reference, thereby enabling the seamless integration of relevant insights into our expanded analytical framework.

The demographic composition of PSLs can be found in section 5.2.2. As a refresher and ease of reference, I offer Table F.7.a here with the same information as section 5.

Table F.7.a

Participants’ Demographics and Flight Experience

Variable		N value	% of total
Gender	Total	542	100%
	Women	28	5.17%
	Men	511	94.28%
	Non-Binary	3	0.55%
Race	Total	520	100%
	Black or African American	25	4.81%
	Latinx or Hispanic	11	2.12%
	White	464	89.23%
	Asian	5	0.96%
	Multiracial	15	2.88%
Tenure - Years	Total	610	100%
	0-5 years	7	1.15%
	6 - 10 years	10	1.64%
	11 - 15 years	31	5.08%

	16+ years	562	92.13%
Tenure Flight Hours	Total	608	100%
	1500 - 3000 hours	6	0.99%
	3001 - 5000 hours	28	4.60%
	5001 - 10,000 hours	110	18.09%
	10,000+ hours	464	76.32%
CA Experience	Total	609	100
	Yes	577	94.75%
	No	32	5.25%

It has been established that the pilot group is a highly experienced group of pilots with most having more than sixteen years of experience (92% N=562), more than 5000 flight hours (94%, N=574), and Captain experience (95%, N=577). The PSL group was highly homogenized (94.28% male, N=511 and 89% White, N=484); thus, the traits of White and male create the 'prototype pilot' categorization (see section 4.5.2 for more on prototype pilots) while all non-White (all genders) and all non-male individuals were collectively categorized as 'non-prototype pilot'.

The survey instrument did not contain queries that directly probed attitudes towards non-prototype pilots, thus presenting a limitation in the assessment of sentiment with respect to specific demographic categories. Nevertheless, a qualitative analysis of open-ended responses to demographic inquiries within the survey provides an indirect avenue to discern these sentiments. This analysis focuses on two questions from Survey 1 that solicited demographic information. The inclusion of an optional write-in response feature was an effort to accommodate a broader, self-identified spectrum of demographic representation. The pertinent demographic questions from Survey 1 are reproduced below for detailed examination and interpretation.

> Survey 1, Question 14: "Gender: How do you identify? (check all that apply)." Options included: "Woman, Man, Non-Binary, Prefer to self-describe, see below" (a blank write-in option was provided), henceforth referred to as "gender question).
>
> Survey 1, Question 15: "Race: How do you identify? (check all that apply)." Options included: "Black or African American, White, Asian, Latinx or Hispanic, American Indian, and Alaska Native, Prefer to self-describe, see below" (a blank write-in option was provided), henceforth referred to as "race question).

Removing duplicate entries as identified by duplicate unique codes, 592 individual responses were recorded for the gender and race questions. The gender question received 31 "Prefer to self-describe, see below" write-in responses while the race question received 48 for a total of 79 write-in responses regarding gender and race. On several occasions (N=25) individuals opted to write responses for both gender and race. Therefore, 54 unique individuals (9.1% of total demographic respondents) opted to write responses for either or both demographic questions.

As the multiple-choice options offered within the survey were quite exhaustive, I was surprised that nine percent of PSLs felt they identified outside the categories offered in the survey. To better understand this finding, I analyzed all written responses.

Six race write-in responses signified legitimate answers, which included the following responses: “N/A, Italian American, Other, mixed race, Asian American, and North African”. One gender write-in response could be legitimate but provided no useful information: *N/A.* Removing these responses from the total count, the remaining 72 write-in responses were illegitimate on various accounts. These 72 responses came from 48 unique individuals; representing 8.1% of the total PSL group who responded to Survey 1.

These 72 responses contained sarcasm, such as “Earthling,” “Human” and “Batman,” as well as anger and aggression, such as “I was born with a penis, I’m a MALE!” and “This is a STUPID question.” On a few occasions, the sentiment was unclear, and the response intent cannot be gleaned without more data. In these situations, write-in responses may have been meant to be comical or interesting, but genuine intent cannot be surmised, as seen with the following examples for gender, “Chicken Dog Hamster” and “I stand up when I pee”. Similar responses were collected for the race question, such as “I look in the mirror and see the color of my skin. I’m definitely white” and “If you’re it 1st, you’re last”.

Some emotional responses showed indications of gaslighting or microaggressions in the form of ‘colorblindness’, as seen in the following examples in Table F.7.b

Table F.7.b
Write-in Responses Displaying Contempt, Aggression, or Gaslighting

Gender question	Race question
“There are two genders”	“Another decisive BS question. We are all humans. Want race to stop being an issue?.. stop making it one!!!”
“How did this become a choice?”	“Human race”
“This question is BS. You are either a man or a woman. Saying you identify as something other than what you are is exactly the same as saying ‘I’m pretending to be…’”	“Woke BS”
“Reject premise of [the] question”	“What the heck is latinX???????”
“Based on the biological truth of science with the required chromosomes of a male”	“I see myself as part of the human race”

The emotional tone of these entries, coupled with their content, underscores a complex undercurrent and sentiment regarding demographic categorization and self-identification within the PSL group. The data indicates that a number of emotionally charged reactions were not only directed at the demographic questions but also at the overarching integrity of the research. Certain Pilot Safety Leaders (PSLs) perceived the solicitation of demographic data as undermining the legitimacy of the survey, and consequently, the importance of the research topic itself. This sentiment, as cataloged in the responses of Table F.7.c, suggests that the inclusion of demographic queries may have elicited concerns among some PSLs about the motivations underpinning the study, potentially precipitating a defensive posture towards the research objectives. Such responses imply a skepticism about the relevance or appropriateness of demographic considerations within the context of the survey, which may reflect broader tensions surrounding the intersection of identity and professional pilots.

Table F.7.c
Write-in Responses Indicating Dislike and Threatening to Devalue the Research

Gender question	Race question
“This is irrelevant to cockpit safety”	“Stupid and unnecessary question. The airplane and gravity do not care how anyone identifies. You’re losing me.”
“This has nothing to do with CRM or flight safety”	“Colorblind…the next question is ridiculous & lends zero credibility to this questionnaire.”
“This is irrelevant to cockpit safety”	“This has nothing to do with flight safety or CRM”
“This is an absurd question. Completely irrelevant!”	“Another completely irrelevant question!”
“Do not understand how this matters.”	“Why does this matt[er]”

While 8.1% does not comprise a majority, PSL’s overt anger at being asked about their race and gender warrants further exploration. Of the 48 unique individuals who wrote in illegitimate responses, 18.8% (N=9) also selected *male*. Of those nine, seven selected *White.* There were no entries of self-reporting as a woman or non-binary who also wrote an illegitimate response. Upon initial analysis, the emotionally charged responses elicited by the demographic inquiries within the survey seem to originate exclusively from individuals who self-identified as White and male. This observation suggests a particular pattern of discomfort or objection within this demographic subset in relation to questions about race and gender. It is important to note that this preliminary assessment is based on the available data, which indicates that the respondents providing such reactions have chosen to identify as both male and White. Further in-depth analysis would be necessary to comprehensively understand the

underlying factors that contribute to this specific demographic's response to the survey's demographic questions.

Recognizing the limited scope of the sample size, it is important to proceed with caution in drawing conclusions from the data, which, due to its limited N values, might be considered inconclusive. Nevertheless, the significance of this inquiry is underscored by the differential experience of microculture among various in-group and out-group members.

F.8 A Note on the Necessity for RQ5

Research question 5 was deemed necessary based on the comprehensive documentation in previous chapters (specifically Chapter 4) highlighting the multitude of challenges faced by women aviators within the professional pilot domain, including bias, sexism, and misogyny. These obstacles encompass navigating stereotypes (4.5.3), gender-based expectations (4.5.1), benevolent sexism (4.4.), and a lack of allyship (4.7), which collectively impose social barriers on non-prototype pilots, particularly women. Given the evident challenges posed by these social barriers, the study sought to investigate whether female aviators might display a heightened initial receptivity to training emphasizing advanced interpersonal skills, relative to their male counterparts. While the primary focus of the research was on the experiential realities of women in aviation, the inclusion of research question 5 reflects a broader acknowledgment of the potential for pilots who are male and of non-White ethnicity to encounter similar social impediments, albeit manifested through racial discrimination. Therefore, research question 5 serves to extend the inquiry beyond gender-specific challenges to encompass broader considerations of social barriers and their differential impacts on various demographic groups within the aviation industry.

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