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Literature Review of Barriers Impacting Female Underrepresentation in Commercial and Military Aviation

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14. ABSTRACT

The aviation career has historically been white and male dominated, despite the increasing racial, ethnic, and gender diversity of the United States. This review focused on identifying barriers impeding gender diversity, and is therefore best leveraged as supplemental information to the USAF's total efforts in building a more diverse military organization. The primary objectives of this study were twofold: (i) identify potential barriers impeding female pilots, based on research conducted in both commercial and military sectors; and (ii) provide potential research-based interventions that may help women overcome these barriers.

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EXECUTIVE SUMMARY

Background and Objective

In February 2022, we conducted a literature review to explore gender differences within the rated community and identify potential blind spots that may be impacting current Rated Diversity Improvement (RDI) efforts. The primary objectives of this study were twofold: (i) identify potential barriers impeding female participation and retention in aviation careers, based on research conducted in both commercial and military sectors; and (ii) provide potential research-based interventions to overcome these barriers.

This study relied solely on existing literature and research, limiting the scope to topics already available in publication/reports. For this reason, differences in barriers across specific military pilot communities (e.g., bomber/fighter) could not be sufficiently determined. However, the barriers and recommendations identified from the available literature are expected to be helpful in mitigating differences in the larger rated community.

Findings

Despite the lifting of combat restrictions, women continue to experience limited growth in numbers and representation as pilots in both the commercial (5.6% female representation) and military (7.7% female representation) sectors, but particularly those in military combat tracks like fighters/bombers (3.1% female representation). Through an extensive literature review of over 70 publications, we have summarized cited barriers as they relate to overarching culture and further by career phase: recruitment, training & performance, and retention.

Non-inclusive culture was the most highly cited barrier impacting the entire personnel lifecycle for female aviators. Personality gender differences were not significant in pilots, and female pilots were more similar to male pilots than non-pilot women. Additionally, for female pilots their personality characteristics were not found to differ based on airframe (e.g., fighter/bomber, tanker/transporter). Barriers endorsed by women in the commercial sector were similar to those in the military and would likely apply to fighter/bombers. Additionally:

- Recruitment barriers included vocational interest, lack of familiarity and awareness of the career, and cost of entry and/or access to opportunities.
- Training/performance barriers included psychological safety issues (e.g., perceptions of tokenism) and uniforms, equipment, and the physical work environment.

- Advancement/retention barriers included organizational culture, career path rigidity, and work/life balance/family planning demands.

Recommendations

We highlighted recommendations based on the findings of our literature review, with the understanding that the USAF is likely incorporating many actions already as part of its RDI efforts. First, long-term commitment to addressing non-inclusive aspects of aviation culture should be a critical component of the AF's ongoing RDI efforts. Additionally:

- Recruitment recommendations included leveraging personality/vocational interest research findings to improve the effectiveness of early childhood outreach, increasing representation of women in informational materials, and providing information on how to pursue a career in aviation, especially estimated costs and available financial aid/ways to reduce costs.
- Training/performance recommendations included exploring incorporation of more diverse coursework into training to address potential gender differences/preferences in learning material and implementing continuous evaluation and assessment of flight equipment and uniforms, accounting for anthropometric differences.
- Advancement/retention recommendations included offering delineated, flexible career development/progression plans and creating informational family planning guides that detail the process and provide helpful resources.

We also recommended the USAF monitor and incorporate the initiatives being implemented by the Royal Australian Air Force (RAAF). The RAAF has been a trailblazer in making intentional and committed progress toward gender equality in its aviation force. Through a combination of programs, policies, and specified goal metrics, they have worked to address many of the barriers discussed in this review.

Lastly, to better understand barriers and factors impacting gender differences in the rated community, qualitative studies (e.g., focus groups, surveys, interviews) with individuals in specific airframe/communities are recommended, especially for gauging interest in choosing a community and perceptions surrounding military aviation culture. Gathering perspectives from male and female pilots using retention and exit surveys can help the USAF determine appropriate D&I goals and have a more complete picture of the state of its aviation force.

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1. STUDY OVERVIEW

1.1. Background/Purpose

Women are underrepresented in most commercial aviation occupations, particularly maintenance (2.6%), aviators (5.6%), and senior leaders (3.0%; Lutte, 2021). Over the last 60 years, female representation in aviation has grown 1% per decade (Lutte, 2021). According to 2019 U.S. Census population estimates, 2020 statistics from the Air Force Personnel Center, and the recent 2021 Racial Disparity Review (RDR), women comprise 50.8% of the U.S. population, 47.0% of the U.S. workforce, 20.9% of USAF personnel, 10.7% of pilot training candidates, and 7.7% of Regular Air Force aviators. The USAF has slightly better representation of female pilots (7.7%) than the commercial sector (5.6%), but is well below the percentage of Air India, which has the highest worldwide representation of female aviators at 12.7% (Lutte, 2021).

Female representation is further disproportionate within the Regular Air Force rated community, with only 3.1% of fighter pilots being women in 2021 (Engel, 2021) compared to the total USAF female pilot representation rate of 7.7%. We were not able to determine a clear-cut reason in the literature for this discrepancy, however barriers endorsed by women in the commercial sector were similar to those in the military sector and would likely apply to the USAF fighter/bomber community. Most importantly, flying ability did not seem to be a major deterrent and rather, other barriers are influencing women to choose not to pursue pilot careers.

The primary objectives of this study were twofold: (i) identify potential barriers impeding female pilots, based on research conducted in both commercial and military sectors; and (ii) provide potential research-based interventions that may help women overcome these barriers. The aviation career has historically been white and male dominated, despite the increasing racial, ethnic, and gender diversity of the United States. This review focused on identifying barriers impeding gender diversity, and is therefore best leveraged as supplemental information to the USAF's total efforts in building a more diverse military organization.

2. METHODOLOGY

2.1. Literature Search Assumptions & Approach

Our literature review was interested in exploring gender-specific differences in perspectives across the rated community, to include pilot, CSO, ABM, RPA and within different communities (e.g., ISR, CAF, MAF, and AFSOC). Research conducted in the commercial sector was also of interest. There was not available peer-reviewed literature on ISR, CAF, MAF, and AFSOC, we recommend conducting future research (including surveys, working groups, and/or interviews) specifically on these communities. We assume differences we identified in the literature may be generalizable to other pilot-related careers. Due to the nature of this request, our literature review focused on gender differences including physical, psychological, or social. We conducted a scoping literature review collecting insights from USAF and military studies and reports and empirical, peer-reviewed literature spanning commercial and military sectors.

2.2. Constraints

Due to perceived survey fatigue and time constraints, we were requested not to survey female aviators directly to collect information relevant to the issue. Developing and administering surveys can require substantial time and resources, and depending on the response rate, may not provide sufficient return on investment (ROI). Additional methods of qualitative data collection, such as semi-structured interviews or focus groups, were also not pursued. However, we recommended that any follow-on studies include some form of qualitative data collection (e.g., working group, interviews, surveys) as part of the USAF's long-term and ongoing sustained diversity and inclusion (D&I) efforts, as it is clear from our literature review that this form of information may provide the most insight in understanding barriers impeding female pilots.

2.3. Limitations

Despite the desire to understand other rated careers, this review was limited to pilots, as this is the population that has primarily been researched in the literature. Within this group, most studies on pilots were conducted in the commercial industry. However, the barriers and consequently, best practices and solutions identified from the available literature could potentially be helpful in mitigating differences in the larger rated community (e.g., pilot, CSO, ABM, RPA). Additionally, we had limited subject matter expertise on the details of all

initiatives involving pilot recruitment and training, including the full breadth of D&I efforts currently undertaken by the USAF. Lastly, our review focused on diversity as it pertains to gender, as underrepresentation of females and gender differences in perspectives were the primary interests. However, the USAF defines and values diversity beyond this demographic. Therefore, our review should best be used as one piece of the USAF's D&I efforts.

3. LITERATURE REVIEW

We synthesized trends/lessons learned from over 70 publications assessing and reporting on gender perspectives and barriers to female aviator careers. These publications consisted of peer-reviewed journal articles, academic papers (e.g., published masters/doctoral dissertations), USAF and partner nation Air Force studies and reports, and commercial sector reports. Irrespective of sector, focal areas included gender perspectives/vocational interests, organizational culture, lack of career awareness, implicit biases/gender discrimination, and work-life balance, explored through a holistic personnel lifecycle lens (e.g., impact of barriers on recruitment/selection, training, retention, etc.).

Historically, there was a significant period of time when women were formally banned from flying combat missions, regardless of pilot training performance, until this prohibition was lifted in 1993 (Engel, 2021). The Combat Exclusion Policy was not lifted from all combat roles until 2013 and was in response to an ACLU lawsuit filed by Hegar et al. v. Panetta (Engel, 2021). Despite the lifting of combat restrictions, women have continued to experience limited growth in numbers and representation as pilots. Women make up a small portion of total USAF pilots and an even smaller number of USAF fighter pilots. According to Engel (2021), 3.1% of fighter pilots in the USAF in 2021 were women. Based on the 2021 RDR, women comprised 10.7% of pilot training candidates, but only 7.7% of total RegAF pilots in 2020. Additionally, women only comprise 5.6% of commercial pilots.

Our review indicated the reasons fueling the disparity of female pilots are incredibly complex. To make sense of the complexity, we primarily used a timeline approach for organizing barriers and providing actionable recommendations for interventions, similar to the Federal Aviation Administration's (FAA) Women in Aviation Advisory Board (2022) report. Using a timeline approach breaks down barriers that contribute to and are influenced by culture into a flexible framework for implementation and allows the USAF to decide which recommendations they want to or are able to undertake, based on time, resources, and other constraints. We also addressed the overarching impact of culture, as all barriers interact and influence each other as a complex system bound by culture. Specifically, we summarized our findings in the following sections with the overarching barrier of culture and then categorized additional barriers by phase: recruitment, training & performance, and retention.

The obstacles we discussed in this report may not represent an all-inclusive picture of the struggles women may face as pilots, as the issue is incredibly multifaceted and our review was drawn from both commercial and military sectors. Thus, it is inaccurate to conclude that Air Force aviation culture requires complete overhauling, as there are likely specific cultural differences between military and commercial aviation, as well as potential differences within USAF pilot track communities (e.g., fighter/bomber v. mobility). Lastly, due to the nature of this review's request, our focus was on highlighting and addressing non-inclusive aspects of aviation culture explicitly shared by female pilots and we did not discuss what women may enjoy about the career and culture.

3.1. Culture as an Overarching Barrier

3.1.1. Non-Inclusive Aviation Culture

Organizational culture is a set of shared assumptions that enable and impact how individuals perceive, think, and feel, and consequently, how they behave (Allaire & Firsirotu, 1984; Schein, 1990; Ravasi & Schultz, 2006). Culture consists of internal and external characteristics. External characteristics are easier to identity, as they are the directly observable aspects of an organization, such as policies, organizational structure, dress code, physical work environment, and language. Internal characteristics are more difficult to pinpoint, as these are the aspects that are not physically observable, such as values, beliefs, and attitudes (Women in Aviation Advisory Board, 2022). Internal aspects of culture are often demonstrated and reinforced through external characteristics, such that focusing change only on one aspect of culture, usually external aspects, will likely not lead to enduring transformation if the change does not reflect the current internal characteristics.

Non-inclusive culture was the most highly mentioned issue cited by female commercial and military pilots in the literature and was heavily attributed to pervasive implicit gender biases (Engel, 2021; Gagliardo, 2020; Lutte, 2021; Marintseva, et al., 2022; NATO, 2019; Women in Aviation Advisory Board, 2022). This trend exists despite existing D&I efforts in both commercial and military organizations. The distinction between internal and external cultural characteristics may explain why D&I efforts have not been successful in improving diversity more quickly, as non-inclusive internal aspects of aviation culture may not reflect the cultural characteristics of what is demonstrated and advertised externally.

Aviation culture is perceived to be highly masculine and in order to succeed, one must be strong, competitive, confident, and risk-taking, personality characteristics that are often associated with men (Chapelle et al., 2010; Connell & Messerschmidt, 2005; Gorlin & Bridges, 2021). While physiological gender differences did not appear to be a significant barrier cited in the literature, many women discussed the indirect impacts of gender stereotypes and biases on perceptions of women's physical, cognitive, and psychological abilities (McCarthy et al., 2019). Female pilots have been perceived by customers and male peers to be less competent and credible flyers and less physically and mentally "tough", which these individuals feel make women a poor fit for aviation (Gorlin & Bridges, 2021; Henneberry, Lubner, & Russo, 2020; Marintseva et al., 2022). Likely influenced by wider societal perceptions that gender differences, whether real or perceived, render certain jobs "inappropriate" for women, the notion of whether women possess personality traits that align well with a pilot career has been questioned.

While gender personality differences have been found in the general population, with men tending to score higher than women for traits like dominance and assertiveness (Feingold, 1994) and excitement seeking (Feingold, 1994; Costa, Terracciono, & McCrae, 2001) and women higher for agreeableness (Weisberg, DeYoung, & Hirsch, 2011), research on pilot personality found female pilots to be more similar to male pilots than women in the general population (Chapelle et al., 2010). Female pilots were revealed to be tough-minded, competitive, achievement-oriented, and willing to consider new and unconventional ideas, characteristics that align with what is often perceived to be important in masculine careers and specifically aviation. Importantly, these female personality characteristics were not found to differ based on airframe (e.g., fighter/bomber, tanker/transporter; Chapelle et al., 2010).

The finding that women pilots are more similar to male pilots than the women in general is poignant, as it contrasts with general literature on gender personality differences, suggesting that women who pursue aviation may be a very unique population. Furthermore, it provides evidence that women can possess the same personality characteristics deemed important by aviation culture, yet some women still do not feel the culture is inclusive of them. One likely reasoning is a catch-22. Women feel they are expected to adapt their personality and behaviors to "match" the masculine culture and "mask" their femininity, however the degree at which they do this has little margin for error. Some women identified in the literature who attempted acclimation to gain acceptance by male peers mentioned being viewed as overly harsh and

unlikeable if they were perceived to be too masculine, but also cited the risk of social exclusion and alienation if they were too overtly feminine (Gorlin & Bridges, 2021).

3.1.2. Culture Recommendations

Changing culture is an ongoing process and requires dedication and support at all levels of an organization and during every stage of the personnel pipeline. Without long-term and ongoing dedication to changing the non-inclusive aspects of aviation culture, interventions proposed in this report will likely not achieve maximum impact. Culture change is complex and should best be approached not as one impossibly big barrier, but as a bi-directional barrier that consists of multiple layers that cannot be addressed all at once. Table 3.1 summarizes recommendations for overarching culture to achieve improvements in aviation gender diversity.

Table 3.1 Addressing Barrier of Culture

Component	*Examples*	*Recommended Guidelines*
Values & Behaviors	• **Workplace socialization/norms (e.g., common language/jargon, humor, "how things are done around here")** • **Leadership socialization/behaviors** • **Decision-making** • **Psychological safety (e.g., being able to show up to work and share ideas/thoughts freely)** • **Diversity and inclusion**	• Develop a clear strategic vision and intention for culture change • Leadership commitment is demonstrated throughout personnel lifecycle and addresses org culture components • Culture change is modeled at the highest level of the organization (e.g., leadership communicates and models expectations and acceptable behaviors and values) • Modify the structural/procedural aspects of the organization necessary to support and sustain organizational change and improve inclusion • Train and socialize newcomers to help them understand expectations, policies, and procedures and develop an understanding of organizational identity and how their individual identity connects with the organization
Structures & Processes	• Pay scales • **Training and development** • Authority (real and perceived) • Performance evaluation system • **Disciplinary actions/policies**	
Things	• **Workspace** • Buildings • **Equipment** • Office layout • **Work attire/uniforms**	
Rituals	• Work outings/events • Storytelling • Award ceremonies	

Note: Bolded bullet points are mentioned/addressed as detrimental barriers encountered by women in aviation but may not be an exhaustive list (e.g., there are many other components of organizational culture and specifically, those that may impede women in this career).

3.2. Recruitment Barriers

3.2.1. Vocational Interest

In a similar vein to personality, research has shown that vocational interests influence individuals' selection of careers. Interest is critical, develops during early childhood, and becomes relatively stable throughout adolescence, plateauing during young adulthood (Hoff et al., 2021; Hoff et al., 2018; Lasselle et al., 2021; Low et al., 2005; Su, Rounds, & Armstrong, 2009). Holland's Realistic, Investigative, Artistic, Social, Enterprising, Conventional (RIASEC) model asserts that individuals seek jobs and work environments that are congruent with their personality (e.g., jobs are not selected at random), which he characterized into six types: Realistic, Investigative, Artistic, Social, Enterprising, Conventional. Generally, research has found men to rate the Realistic type higher and women the Social type (Betz & Gwilliam, 2002; Fouad, 2002; Tracey & Robbins, 2005). More research found Realistic and Enterprising types to be more masculine, with men endorsing Realistic as their top interest 32% of the time compared to women's 4%, while women rated Artistic and Social types as their top interest (Lasselle et al., 2021; Vock, Koller, & Nagy, 2013).

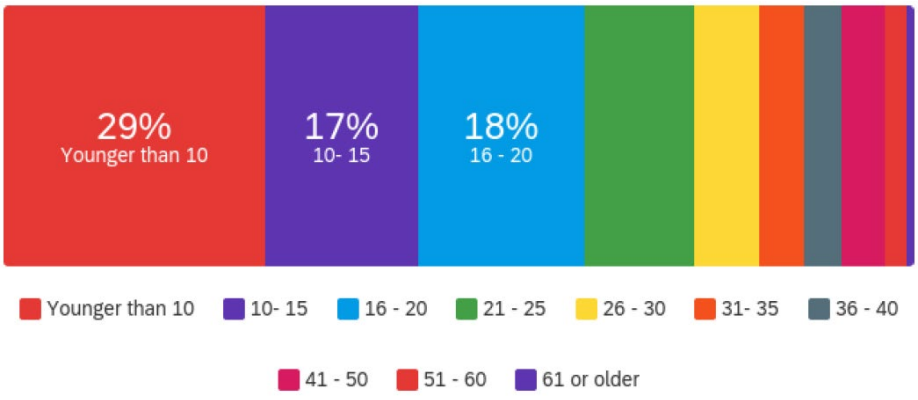
While there has been inconclusive evidence in the literature that women have expressed less interest in aviation, and more specifically in the fighter/bomber tracks, research on vocational interests may still provide insight as to why female representation has been slow to increase. The Department of Labor (DoL)'s O*NET website utilizes RIASEC codes in the "Interests" section for all of its occupational listings. Commercial pilots are coded RIE, indicating that the career frequently involves hands-on, practical work activities using real-world materials (Realistic), working with ideas that require critical thinking and fact finding (Investigative), and involve making frequent decisions that can require risk taking (Enterprising; O*Net, 2022). With men tending to prefer Realistic and Enterprising types, it is logical for occupations like aviation to be more desirable and actively pursued by men than women. The RIASEC model asserts that individuals mentally assess how well a career/environment fits their own personality type, such that over time, vocational choices may become more rigid, as individuals will be motivated to seek out only these "good fit" opportunities (Nauta, 2010). If women do not endorse early interest in the Realistic type, they may not even attempt to pursue learning about being a pilot, maintaining the current status quo of it being a predominantly male-oriented and subsequently, male-dominated occupation. This then impacts the work environment

and culture, which will reflect the primary characteristics of the people that pursue the career (e.g., male and masculine) and reinforce the perception that it is not a suitable career for women.

3.2.2. Sparking Interest Early

Many female pilots across commercial and military sectors endorsed a lack of awareness of being a pilot as a career option for women (Gagliardo, 2020; Lancia, 2017; Marintseva et al., 2022; Seligson, 2019; WIAAB, 2022). In line with the vocational interest literature, research on educational outreach has found that children begin pondering future careers in the 9 to 12 age range (Eiff 1989; Gagliardo, 2020). Similarly, Lutte (2018) found that 29% of women first became interested in aviation before the age of 10 (Figure 1). Additional research supports this finding, with girls as young as eight engaging in occupational segregation and making attributions as to what is "correct" or "appropriate" kinds of work for women (Gutman & Akerman, 2008). Girls felt themselves to be more interested in people-oriented/caring roles and boys in working with things (Chambers et al., 2018). Master, Meltzoff, & Cheryna (2021). This loss of interest could be a result of developed gender-interest stereotypes, where girls as early as age six begin believing that boys are more suited to STEM-related areas than girls, which then lowers their interest in pursuing these areas. A few studies have specifically looked at early interest and awareness of aviation. Drawing the Future (Chambers, 2018) asked children to draw a picture of a fighter pilot and found that 92% of the characters drawn were male. A study by Foster (2016) found that for both men and women who went on to become pilots, the decision to do so had solidified before age 20 (Gagliardo, 2020).

Figure 1. Age women first became interested in aviation (Lutte, 2018)



While there is evidence for gender differences in vocational interests, they are not hard-wired and can be shaped by various sociocultural factors (Hyde, 2013). Lancia (2017) found that all of the aviation students in her study cited an early association with flying. Her research is further supported more recently by Gagliardo's (2020) study with female aviators, where 90% of the 11 female pilots interviewed mentioned experiencing an aviation-specific event and 79% cited exposure occurred in early childhood. However, in Gagliardo's (2020) study, exposure to an aviation event alone was not sufficient in influencing women's perceptions of aviation as a career. Other factors, such as unconditional parental support for non-traditional female careers, teacher encouragement, and media portraying aviation or women in non-traditional roles were mentioned as impactful (Gagliardo, 2020). Thus, efforts to encourage women to pursue aviation should be made beginning in early childhood and through adolescence, which are pivotal periods for interest development (Hoff et al., 2021).

3.2.3. Sparking Interest Early Recommendations

The key takeaway from research on vocational interests, personality, and qualitative interviews with female pilots is that aviation does not readily come to mind as a career opportunity for women. This could be due to lack of vocational interest, where women tend to endorse less interest in Realistic type careers, in which the pilot career falls. However, based on female pilot interviews, the reason seems to be more due to lack of awareness of the career and the absence of female representation in aviation, all of which can affect interest. It is difficult to spark interest in young girls for a career that they cannot "see" themselves in. Lack of representation can also reinforce budding gender stereotypes that aviation is not a female-appropriate or friendly industry (Gibbon, 2014b). For those that pursued aviation, seeing female pilot role models was highly impactful and influential for both visible representation (e.g., seeing women as pilots) and mentoring opportunities (e.g., social and professional support across career pipeline; Bridges, Neal-Smith, & Mills, 2014; Cline, 2017; Gagliardo, 2020; Henneberry et al., 2020; Lancia, 2017; Marintseva et al., 2022). Additionally, exposure to an aviation event in childhood influenced many women to consider the career, suggesting that vocational interest is there, but must be kindled early (Gagliardo, 2020).

Thus, recruitment efforts should focus on sparking interest in young girls. Outreach and recruitment campaigns, such as sending recruiting teams to give presentations at schools has been recommended by and implemented in 21 NATO members and partner countries, including

the U.S (see Appendix A). Outreach should be ongoing and consist of a mixture of "hands on" aviation-based events and opportunities for young girls to interact and engage with female pilots. School counselors need to be more active in implementing career coaching beyond "traditional" careers (Lancia, 2017). Aviation organizations as well as military organizations like the USAF may need to get creative in how to approach outreach, such as utilizing a partnership with elementary schools, where students can experience real-world aviation activities as part of their regular schooling. This approach was found to be highly effective for improving confidence as well as interest in STEM in an Oklahoma school, particularly for girls (Redmond et al., 2011) and other research has found educational outreach to be promising for motivating interest (Milgram, 2011; Tallman, 2011; Lutte, 2021). Early outreach efforts should be supplemented with increased visibility of women in media and recruitment materials.

The Royal Australian Air Force (RAAF) has utilized much of what has been suggested by research and have implemented a range of initiatives that the USAF could emulate. In 2013, they started hosting experiential Flight Camps and Technical Camps for young women in the 16-18 age range to explore military aviation and have direct access to RAAF recruiting specialists to discuss career opportunities (Gibbon, 2014c; PricewaterhouseCoopers (PWC), 2017). EasyJet has employed similar efforts and deploys its female employees to speak at events and offer mentorship to new female pilots (Ferla & Graham, 2019). The USAF could and should increase investment in these types of initiatives and doing so would allow young girls to begin seeing and developing a career plan for themselves as pilots, receive informal mentorship, and help fight perceptions of aviation being inappropriate for girls (Gibbon, 2014a; Marintseva et al., 2022).

The RAAF has made intentional efforts in increasing female visibility in recruitment materials (e.g., website, career profiles of female pilots) as well as publishing gender-specific informational guides. Most recently, the RAAF has replaced the term 'airmen' with 'aviators', an additional visible acknowledgment of its dedication toward diversity and maintaining a culture of inclusion (Reuters, 2021). The USAF's own website lacks a strong female presence, but especially so on its main informational splash page for the pilot career, which has no images of female pilots (AirForce.com, 2022). Increasing physical cues by way of images and stories of female pilots is an opportunity for the AF to help women "see" themselves as pilots and potentially feel more encouraged to learn more about the career.

Initiatives aimed at early outreach may not offer immediate returns for increased recruitment, but is likely to prove impactful over the long-term when paired with intentional culture change. Recruiting more women will not be beneficial for increasing female representation if women find working conditions hostile. Leadership must be committed to doing the work on the inside to ensure that what is represented in recruitment efforts reflects a culture committed to supporting and providing allyship to women and showing zero tolerance for sexual harassment, bias, and discrimination.

3.2.4. Cost/Access to Opportunities

Cost of entry was rated second to culture as the biggest barrier for women pursuing aviation (Women in Aviation Advisory Board, 2022). Unlike the commercial industry, which can have significant flight time hour requirements ranging from 1000 to 7000 hours (Zheng, 2016), the USAF has no set minimum required number of flying hours. However, the USAF has conducted analysis on training outcomes and those with a greater number of flight hours tend to be top performers (Couse & Meek, 2021). Acquiring flight hours prior to commissioning requires having access to opportunities, as well as being able to finance these opportunities, such that flying hours can be a stronger reflection of socioeconomic status and mask flying ability for those unable to obtain additional flight training. Current financial aid often does not meet the financial strains of pursuing both a four-year flight degree and the additional costs of flight training, which can range between $50,000 and $80,000 (Women in Aviation Advisory Board, 2022). From the military's perspective, training pilots is extremely costly, particularly for fighter and bomber pilots, whose training ranges from $7.3 million to $9.9 million per pilot (Mattock et al., 2019). USAF data shows that women tend to have less flying hours than men (Studies and Analysis Squadron, Rated Diversity Improvement Data Collection and Analysis Dashboard, ongoing efforts), which may be due to the high cost of flight training rather than poor flying ability or lack of interest/dedication. Ongoing efforts are exploring the removal of flying hours (or higher ranges of flying hours) from the Pilot Candidate Selection Method (PCSM) score for the pilot candidate selection process. These efforts may help reduce potential bias in pilot selection for women, who tend to have less flying hours and lower PCSM scores than men (John & Buck, 2021).

3.2.5. Cost/Access to Opportunities Recommendations

Many aviation organizations have launched initiatives for increasing financial access to pilot training. Women in Aviation International (WAI) offers educational outreach programs and administered $831,365 worth of scholarships in 2020 (Marintseva et al., 2022). Aircraft Owners and Pilots Association (AOPA) and Experimental Aircraft Association (EAA) maintain lists of scholarships offered by different aviation associations and groups, as well as its own scholarships. Most scholarships offered appear to be open to all applicants, but the FAA maintains a listing of scholarships designated specifically for minorities and women. CAE Aviation employs a Women in Flight scholarship aimed at addressing female underrepresentation. Recipients of the scholarship serve as ambassadors and CAE publicizes their journey to becoming a pilot on social media, which is a great way to showcase female role models in aviation, as well as inform young women of the process. The USAF has made concerted efforts to offer financial aid, such as the USAF JROTC Flight Academy Scholarship. As of 2019, Australia was the only NATO partner country to endorse female-specific financial aid (see Appendix A), such that the USAF could be the first American entity to follow suit. Finally, the USAF should continue its efforts in assessing and evaluating the selection processes and criteria (e.g., number of flying hours) used to train, develop, and assign individuals to different pilot tracks.

Table 3.2 Addressing Barriers to Recruitment

Barrier	*Initiatives*	*Recommended Reading*

Lack of interest and awareness of pilot career for women	• Target outreach during elementary school years (as early as kindergarten)
	• Outreach should be long-term, ongoing, and consist of experiential "hands-on" activities
	• Develop partnerships with elementary schools and provide opportunities for young girls to interact with women in the career and receive SME information/support on potential career paths in aviation
	• Provide "hands-on" aviation experiences, such as flight camps
	• Counselors should take active role in career development
	  o Administering vocational interest inventories beginning in early elementary school and tracking interests to guide career development planning
	  o Active encouragement of girls to pursue aviation
	• Provide training to teachers to mitigate biases that may prevent them from encouraging girls/women to pursue STEM/aviation-related careers
	• Expose children to alternative representation in media and instructional materials (e.g., challenging gender norms) and utilize social media platforms to influence children's perceptions early on
	• Aviation organizations provide funding to elementary schools to provide experiential aviation opportunities/experiences
		Women in Aviation Board (2022). p. 53–58, 62–64.
		
		Gagliardo (2020). p. 3–11, 23–26, 29–33, 38–40, 41–48, 42.
		
		Marintseva et al. (2022). p. 144, para. 2.3.1, p. 149, para. 4.2.1.b)
		
		NATO (2019). p. 47
		
		Seligson (2019). p. 12, para. 3.2; p. 13, fig. 2
		
		Lancia (2017). p. 59, p. 61–63
		
		Keller et al. (2018). p. xiii, table S.1.

Sparse female representation in media & advertising and female career role models	• Increase the presence of women in media (e.g., photos/videos/stories) on websites and in brochures • Using inclusive language in materials • Provide role models that display technical ability, while still being perceived as feminine • Schools should promote non-traditional role models in schools • Women's professional aviation groups need to promote aviation to young girls and women more frequently than once a year	Women in Aviation Advisory Board (2022). p. 36–37, 47–48. Gagliardo (2020). p. 3–11, 23–26, 29–33, 41–48. Marintseva et al. (2022). p. 145, para. 2.3.6, p. 147, para 4.2 Lancia (2017). p. 60
Cost/access to opportunities to pursue career	• Provide information on how to pursue a career in aviation, especially estimated costs and available financial aid/ways to reduce costs • Maintain active list of available financial aid sources (e.g., scholarships, grants, internships, tuition re-imbursements) • Establish target goals to monitor recruitment of women (e.g., rate of women recruited v. how many are selected/hired); continue evaluation of selection methods	Women in Aviation Board (2022). p. 60–61. Marintseva et al. (2022) p. 146, para. 2.4

3.3. Training/Performance Barriers

3.3.1. Psychological Safety

Tokenism was cited as a stressor for women in commercial and military aviation, with female pilots in many studies citing an increased sense of pressure to prove their competency and suitability for the career because they were the only women at their squadron (e.g., having to represent all women; Engel, 2021; Gagliardo, 2020; Women in Aviation Advisory Board, 2022). This pressure is likely exacerbated by findings that male colleagues as well as passengers have shared beliefs that female pilots are less skilled and trustworthy (Ferla & Graham, 2019; Marintseva et al., 2022) and from women's experiences of sexual harassment. Harassment and gender stereotypes negatively impact performance and reduce group cohesion, while contributing to a culture of hostility (Engel, 2021). Perceptions of tokenism often arise in environments that are unbalanced, such that whoever is the dominant group has substantial influence in fostering a culture that reflects their own values, beliefs, and behaviors, and anyone outside of that group may feel they are highly visible and under intense scrutiny. In the case of aviation, women may feel increased pressure to prove their competence and sense of belonging in the career to their male peers to avoid perceptions of being a token hire (e.g., hired only because of their gender) and minimize experiences of harassment. Additionally, women may feel they have to adopt more "masculine" behaviors to avoid stereotype threat (e.g., fear of fulfilling negative stereotypes of oneself). Having to mask one's authentic self can undermine psychological safety and in turn impact physical safety on the job, where women may feel less comfortable and qualified to speak up about errors or problems (Women in Aviation Advisory Board, 2022). Women described flight training as a lonely endeavor due to the lack of female instructors and perceived differences in learning styles (Marintseva et al., 2022; McCarthy et al., 2019; Zheng, 2016). Thus, it may not be surprising that female pilots often felt they had to acclimate in order to appear more credible and gain acceptance from male peers (Engel, 2021).

As a reflection of performance barriers, historically women have higher attrition than their male counterparts in specialized undergraduate pilot training (SUPT; John & Buck, 2021). Women made up 7.80% of SUPT candidates, with a 9.81% attrition rate, compared to men's 92.20% of SUPT candidates and 6.64% attrition rate. Reasons for attrition during undergraduate pilot training varies across gender with males being more likely than females to attrit for academic reasons and requests to drop training and females more likely to attrit due to medical

reasons (John & Buck, 2021). Flying performance is the most common reason for attrition for men and women across all phases of AETC undergraduate flying training (John & Buck, 2021).

3.3.2. Psychological Safety Recommendations

Aviation and military organizations are tasked with the fine balancing act of helping to mitigate women's feeling of being highly visible as "the only" female in a squadron, which can subject them to feelings of increased scrutiny and social isolation, while also not lumping all female pilots together at squadrons on the basis of being female. Perhaps the best balanced solution would be to try and group women together when possible and appropriate, but also provide resources like women's networks outside of squadrons that give women ongoing opportunities to connect and interact about their experiences (Bridges et al., 2014). In Australia, Women's Integrated Networking Groups (WINGs) and Flying Females Breakfasts were implemented in 2011 at all RAAF bases to give female pilots the opportunity to network with other service women (Gibbon, 2014c). Thirty-eight NATO countries have made concerted efforts to incorporate gender perspectives into operational planning and 21 have women's military support networks (see Appendix A). Lastly, a culture that tolerates work environments rife with gender stereotypes will, unsurprisingly, experience training and performance detriments (Engel, 2021). Individuals should be able to confidently be their authentic selves at work without fear of being viewed negatively or seen as a threat (e.g., psychological safety), which will require intentional commitment and efforts for culture change at all levels of an organization.

3.3.3. Uniforms, Flight Equipment, Physical Work Environment

External representations of aviation's cultural values can be signaled by things like uniforms and flight deck design. In addition to ensuring pilots can do their jobs safely and effectively, care needs to be taken to also ensure uniforms, equipment, and the physical work environment does not reflect a system designed only for men. These aspects are less frequently endorsed as deterrents, however women need to have the resources necessary to do the job safely and effectively. On average, women are smaller than men, which is an important anthropometric difference to consider for determining flight suit and cockpit design (Insinna, 2020). Bladder relief systems have been a constraint for all pilots, but especially women, who have not been able to adequately use equipment like piddle packs, which are often used by male pilots, and instead resort to using adult diapers or tactical dehydration (Roza, 2021). Tactical dehydration puts female pilots at danger by lowering G-tolerance and can cause altered vision and overall reduced

cognitive performance (Roza, 2021). Recent alternatives to piddle packs, such as Skydrate and Advanced Mission Extender Devices (AMXDs) have been met with mixed reviews by women.

3.3.4. Uniforms, Flight Equipment, Physical Work Environment Recommendations

The USAF has made strides in improving inclusiveness of physical requirements and equipment, along with 13 other NATO countries (see Appendix A). The USAF recently modified the height requirement, which may have previously discouraged women from pursuing the pilot application process, whether due to the stigma of asking for a waiver or lack of knowledge that this requirement could be waived (Losey, 2020). Additionally, women can continue to fly while pregnant without a waiver and in the future, will have a maternity flight suit to accommodate pregnancy for those who wish to continue flying during that time (Ryan, 2020).

Table 3.3 Addressing Barriers to Training/Performance

Barrier	*Initiatives*	*Recommended Reading*
*Psychological safety**	• Explore incorporation of more diverse coursework into training to address potential gender differences/preferences in learning material ○ Offer ongoing training geared at topics like allyship (e.g., men supporting women), group dynamics, implicit biases, sexism) • Leverage opportunities for women to network and connect with each other to mitigate feelings of loneliness and isolation • Develop team building exercises/opportunities for cohesion building within units • Establish clear policies and methods for redressing inappropriate behaviors • Specify clear and measurable goals targeted toward improving culture change • Educate individuals in positions of leadership in how their communication, behaviors, and practices are interpreted and model what is deemed acceptable in the workplace *Leadership support and commitment to culture change is important for enforcing expectations of inclusion and fostering an environment promoting psychological safety of individuals to feel comfortable expressing their authentic selves	Women in Aviation Advisory Board (2022). p. 40–41, 44–46, p. 50, 52–53 Gagliardo (2020). Against the wind: A study on aviation as female career choice. p. 3–11, 23–26, 29–33, 41–48. Engel (2021). p. 14–17, 88–96, 116–118, 137–144, 319 NATO (2019). Summary of the national reports of NATO member and partner nations on gender perspectives. p. 47 Marintseva et al. (2022) p. 147, para. 4.2.1, p. 149, para. 4.2.1.b), p. 145, para. 2.3.3 Lutte (2021). p. 4
Uniforms, flight equipment, physical training/work environment	• Continuous evaluation and assessment of flight equipment and uniforms, accounting for anthropometric differences • Assess and implement learning techniques that can help meet unique individuals' learning styles and needs	Women in Aviation Advisory Board (2022). p. 48–49 Engel (2021). p., 88–96, 118–122 Mutisya (2010). p. 24–25 Keller et al. (2018). p. 46 NATO (2019). p. 43–44

3.4. Advancement/Retention Barriers

3.4.1. Organizational Culture

While culture underlies all stages in the pilot pipeline, it was explicitly mentioned as a detriment to retention in the commercial sector, with 59% of women endorsing untenable working conditions as influencing their desire to leave aviation (Women in Aviation Advisory Board, 2022). Implicit gender bias and discrimination was the top influencer, with 62% of women indicating that sexual harassment was a huge problem and 81% reporting witnessing it (Women in Aviation Advisory Board, 2022). False perceptions of equality (e.g., tokenism, dissonance between external and internal aspects of culture) and credibility gaps (e.g., gender stereotypes that women are less skilled/capable of flying) serve as cultural barriers to retaining women, as it impedes their ability to feel supported and safe at work (Women in Aviation Advisory Board, 2022). Women may feel "allowed" into aviation, but if they don't feel like the environment is welcoming and inclusive, they will not feel a sense of belonging and want to remain in the industry long-term. This then impacts advancement of female pilots into leadership and mentorship roles and perpetuates the vicious cycle of underrepresentation of women entering aviation. Achieving culture change requires significant time and commitment from senior leadership to develop strategy and implement policies and methods that both demonstrate dedication to change, as well as develop explicit measures that hold the organization and its employees accountable for unprofessional and non-inclusive behaviors and working conditions. There is not one magic bullet solution to create culture change and all of the recommendations provided in this report may help improve the non-inclusive aspects of aviation culture.

3.4.2. Career Development & Work/Life Balance

Another commonly mentioned barrier in the literature concerns work-life balance demands. A 2018 RAND study found that many female Air Force Officers described difficulties with managing a military career and a family due to the significant time investments required by both (Keller et al., 2018). Pilots, especially those flying fighters or bombers, can often be expected to work more than 40 hour weeks and exhaust the maximum duty day of 16 hours (Engel, 2021). Air Force Child Development Centers (CDCs) often have limited hours, disproportionately affecting individuals employed in career fields with non-traditional work hours, such as pilots. Lack of appropriate breastfeeding facilities, along with work schedule arrangements that allow mothers to pump, is an additional limitation. Furthermore, a leisure gap

still exists, where women often work additional hours outside of work and take on more of the domestic labor than men. Therefore, it should be little surprise that women often describe feeling more psychological stress in maintaining work-life balance, even for those with partners. For dual military pilots, there is the additional stressor of not being assigned to the same duty station, which can limit career progression for one or both individuals, as well as increases the potential need, and consequently expenses, for childcare (Smith, 2010; Keller et al., 2018; Engel, 2021).

Women in aviation who are planning to have children may experience extra tension between motherhood and career demands (Taber, 2013). For instance, female fighter pilots have reported feeling like they are prohibited from having children, as pregnancy would disqualify them from flying (Keller et al., 2018). Additionally, there can be "unwritten" career culture rules that discourages women from becoming pregnant because it is perceived as an inconvenience to the organization (e.g., other pilots having to fill in and "pick up the slack"; Taber, 2013; Keller et al., 2018; Engel, 2021). Even for those who are not deterred by these potential constraints, there is still the matter of timing pregnancies within rigid career timelines, where some women have voiced concerns about losing career opportunities and progression due to pregnancy (Keller et al., 2018; Zheng, 2016). Others have voiced concerns with disclosing family planning information to leadership due to the negative stigma that pregnancy is used to get out of pulling one's weight or for avoiding deployments (Keller et al., 2018). Some women cited having to "manufacture" career breaks for themselves in order to balance career and family demands (Engel, 2021).

Ultimately, difficulties balancing career and family seem to stem from career path inflexibility, with women feeling like career progression is rigid and few alternative paths are available that may afford them more compatibility with their family and personal lives. There is some evidence in the literature that suggests lengthy contract obligations are undesirable, such that women did not even attempt to start the application process to become military pilots (Mitchell et al., 2014). This is likely due to incompatibility with having both a career and a family and in its current state, military careers may not offer enough assignment flexibility for women to feel they can successfully accomplish both. Lastly, there are policies in place that may be discouraging women from pursuing or continuing to serve as pilots, such as having to submit a waiver to fly while pregnant (Maucione, 2022). This requirement has since been modified, but its effects may still be felt for some time.

3.4.3. Career Development & Work/Life Balance Recommendations

Training, as well as potential health costs associated with the risks of flying are high. It is beneficial for financial, performance (e.g., training ROI, employee retention), and employee well-being to have clearly delineated career plans that outline progression stages and details how the employee's own personal and professional goals/milestones can fit into this plan (Marintseva et al., 2022). It is highly recommended that the USAF continues to incorporate flexibility into career planning and demonstrate that there is not one single rigid path for individuals to achieve their career goals. For women, this would likely entail allowing for time off during/post-pregnancy and offering flexible phased returns to work/work schedules that accommodate childcare and domestic commitments, while allowing female pilots to accrue sufficient flying hours and maintain a career (Engel, 2021; McCarthy et al., 2019). As of 2019, 34 NATO member nations and partner nations offer paid maternity leave, 33 offer paternity leave, 28 allow parents to transfer leave between each other, and 15 offer additional subsidized leave (see Appendix A). Additionally, 30 countries offer some type of flexible work policy(s) and 14 guarantee dual service couples with children will not be deployed at the same time.

Employing career and family planning policies and initiatives alone is not sufficient, as there is still a perception that not being able to fly due to family reasons is not legitimate and comes at a cost to the organization (Mitchell et al., 2014; Neal-Smith, 2014). Beneficial and accessible family planning policies can interact with women's perception that the USAF values personal life choices and that it is possible to have both a career and a family. Role models again play another important aspect in helping women understand, create, and balance a career plan for themselves (Marintseva et al., 2022). Being able to physically see other women manage the career and a family is incredibly important for up-and-coming young pilots (Ferla & Graham, 2019). Individuals like career field managers (CFMs) can also play a critical role in reinforcing perceptions that work-life balance is valued. This can be accomplished through having one-on-one meetings with Airmen to develop individualized career path plans that align with their goals and expectations (Marintseva et al., 2022). Additionally, CFMs can provide Airmen with helpful resources and remind them of existing policies that are in place for their needs.

The RAAF has undertaken various initiatives toward improving women's work-life balance. They have implemented more flexible work policies, mentoring/support networks, and created personnel diversity guides, which detail such information as managing parenthood and a

flying career and flexible career options. They have also demonstrated their commitment through formalized endorsement, such as receiving accreditation as a breastfeeding friendly workplace (Royal Australian Air Force, 2022). The USAF has AFIs, but no guides specifically tailored toward providing a timeline of details for navigating each stage of pregnancy and what specific regulations, forms, or websites may be helpful during each stage. A female NCO in 2020 compiled an informal nine-page manual that provides information to pregnant Airmen navigating all aspects of motherhood (Cohen, 2021b). Her guide received so much attention and praise, she is now partnering with the Women's Initiatives Team (WIT) to transform it into an official USAF document (Cohen, 2021b). The WIT is a women's committee, in line with NATO's (2008) recommendation, geared toward implementing lines of effort focused on removing barriers faced by both service and civilian women. However, career fields, particularly male-dominated ones such as pilots, may stand to benefit from supplementing the work of WIT with their own women's initiatives teams that can focus on the specific unique experiences of women in their career, and consequently, respond to challenges and barriers they face that may not apply to the general female USAF population.

Table 3.4 Addressing Barriers to Advancement/Retention

Barrier	*Initiatives*	*Recommended Reading*
Org culture	• Leverage professional development opportunities for current female pilots to serve as role models and leaders; serves two-fold purpose of providing essential navigational support to women and helps build and sustain inclusive culture • Encourage male leaders to sponsor women, advocating and increasing opportunities for them to improve their visibility and capabilities for advancement • Create and utilize an ongoing mentorship program, as mentors can spread knowledge and help drive cultural change • Form collaborations with other organizations and entities that are driving meaningful change to utilize/share best practices • Foster social dialogue within the aviation industry, partnering with other organizations dedicated toward fostering and improving cultural inclusion	Women in Aviation Advisory Board (2022). p. 68–69 Engel (2021). p. 320–326, 326–340 Gagliardo (2020). p. 40 Marintseva et al. (2022). p. 145, para. 2.3.6, para. 2.3.3, Seligson (2019). p. 14–15, para. 3.3; p. 16, fig. 4; p. 31–34, para. 5.4 Mutisya (2010). p. 20–22 Ferla & Graham (2019). p. 3 – 5; p. 12, table 2 Lancia (2017). p. 55, p. 61 Keller et al. (2018). p. 28–31
*Family planning demands**	• Create informational family planning guides that detail the process and provide helpful resources • Allocate sufficient maternity leave time, ideally providing paid leave at 100% of an employee's pay rate • Increase availability of on-base childcare • Implement policies/acquire certifications that foot-stomp dedication toward family planning • Foster efforts to co-locate dual military spouses *Intentional ongoing culture change to combat negative perceptions of pregnancy/motherhood is imperative to ensure policies are utilized by women and respected by male peers	Women in Aviation Advisory Board (2022). p. 65–67. Engel (2021). p. 140 Seligson (2019). p. 17, fig. 5, p. 25–26, para. 4.3.2 Lutte (2021). p. 5 Keller et al. (2018). p. 14–19; p. 42–44
Limited career development planning, flexibility, and advancement opportunities for women	• Create and implement flexible, and individualized career development plans • Coordinate career plan goals with pilots early on; incorporate family planning as part of career path • Leadership/CFMs should be conducting ongoing career plan checks and ensure pilot's career and personal goals are still being met • Leadership actively reinforces perceptions that work/life balance is valued (modeling actions/behaviors that align with this principle) • Leverage women's initiatives team to provide ongoing analysis and feedback of women's needs	Seligson (2019). p. 17–18; p. 18, fig. 6 Keller et al. (2018). p. 24, 44–46

4. CONCLUSION AND FUTURE DIRECTIONS

Based on a scoping review of the literature, women may not be actively discouraged from the pilot career, but they also do not feel encouraged. What may appear as disinterest more likely stems from lack of awareness of aviation as a viable career for women. Then, for those who do pursue aviation, other barriers, such as culture and poor work-life balance impact their decision to have a career in aviation. For female military pilots who remained in the career and wanted to have a family, many cited having to carefully time their family planning and felt they were only able to continue to fly by outsourcing childcare (e.g., nanny, partner took on caretaking). Those who did not have children stated they felt career progression was only possible because their partner was able or willing to accommodate their flying schedule and through successful acclimation to the predominantly male aviation culture.

The RAAF has been a trailblazer in making intentional and committed progress toward gender equality in its aviation force. Through a combination of programs, policies, and specified goal metrics, they have worked to address many of the barriers discussed in this review. Many of the initiatives undertaken by the RAAF could be replicated in the USAF, such as increasing female presence in recruitment and advertisement materials, offering more flexible working arrangements and career path progression plans, increasing family planning support resources, and connecting female pilots with each other via women's networks and events.

Strides that have been made toward achieving gender equality have often been a result of women taking initiative to voice concerns. Thus, it only makes sense to follow in the steps of the RAAF and "leave gender in", giving women opportunities to provide feedback on their own experiences and utilize suggestions they may have that will make their flying experience better. The USAF has implemented some policies and initiatives suggested by NATO (2008) and utilized by other countries (see Appendix A), to improve gender balance in the Armed Forces, such as recognizing body differences when procuring equipment/clothing, implementing more family support initiatives, and employing women's working groups (e.g., the WIT).

4.1. Value of female aviators

Boeing estimates that 612,000 new civilian pilots will be needed worldwide over the next twenty years in response to an aging workforce and projected fleet growth (Boeing, 2021; WIAAB, 2022). In 2020, the USAF reported an increase of 200 pilots, which may have in part been due to decreased commercial airline hiring due to the global COVID-19 pandemic (Cohen,

2021a; Johnson, 2022). However this gain still left the USAF short 1,900 of the approximately 21,000 pilots desired (Cohen, 2021a). Of the manned aircraft pilot jobs, mobility aircraft were 100% manned and combat search and rescue, command control, and intelligence surveillance and reconnaissance aircraft were overmanned at 118%, while fighter, bomber and special operations aircraft were undermanned at 82%, 84%, and 89% (Cohen, 2021a). The COVID-19 pandemic has also challenged the commercial aviation industry's staffing, in conjunction with ongoing factors like an aging workforce and FAA mandated age requirements (e.g., mandatory retirement at age 65). Pilot shortages are an excellent opportunity to focus recruiting efforts toward untapped populations that may not have ever considered a career in aviation, such as women. Military pilots often leave the Services in pursuit of better benefits in the private sector. However, military female pilots might be more inclined to stay if they were aware female pilots had higher representation in the USAF, which in turn may signal better professional/career support and inclusion of women, than in the commercial industry. Recruiting more women, particularly for undermanned airframes/communities, would not only address manning problems, but simultaneously would increase female representation and reap the many benefits of diversity (e.g., enhanced safety, innovation, profitability; Hunt, Layton, & Prince, 2015; Women in Aviation Advisory Board, 2022). The USAF's larger number of female pilots may give it a significant edge over the commercial sector in recruitment and retention efforts.

4.2. Tracking progress towards identified goals

Collecting metrics and tracking data points is key for measuring progress and evaluating ROI of recruitment and retention efforts, especially when the USAF has sought $18 million a year for its RDI through 2025 (Cohen, 2021a). Data tracking should be specific and broken down by airframe, as it is clear that fighter, bomber, and special operations airframes are undermanned as well as gender unbalanced. While the focus is generally on increasing female representation, it would be helpful to track disaggregated race and ethnicity data for later analysis of intersectionality of representation (e.g., disparity of female racial/ethnic minorities; Women in Aviation Advisory Board, 2022). While large aviation organizations, such as the FAA, maintain data on pilot certification, breakdown by additional underrepresented group categories is not available. This is an excellent contribution opportunity for the USAF to track and publish data and trends to further understanding of the state of representation in aviation, and particularly in the military sector.

4.3. Data calls, interviews, surveys, and working groups

Congress established the Women in Aviation Advisory Board (WIAAB) in 2018 to identify barriers and develop recommendations to the FAA for improving underrepresentation of women in aviation. This move signifies building momentum toward efforts to improve barriers impeding women and encourage their participation in aviation. The USAF has a women's initiatives team working group, however, it is clear that female aviators have unique needs and challenges and could benefit from having a unique women's working group, similar to the WIAAB. Perhaps even better might be women's working groups at the rated community level (e.g., CSO, ABM, RPA), as there may be variation in barriers experienced by female aviators within different communities. While there is general consensus in the literature that factors like lack of awareness/outreach, cost of entry, workplace culture, and work-life balance are challenges that transcend sectors, in order to better understand barriers and factors impacting gender differences in the rated community, qualitative studies (e.g., focus groups, surveys, interviews) with individuals in a specific airframe/community is recommended, especially for gauging interest in choosing a community and perceptions surrounding military aviation culture. Additionally, gathering perspectives from male and female pilots using retention and exit surveys can help the USAF determine appropriate D&I goals and have a more complete picture of the state of its aviation force.

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APPENDICES

Appendix A. NATO Best Practices to Improve Gender Balance

Recruitment	*NATO Member Nations*		*Count*	*Commercial*
Used policies to promote recruitment of women	Albania, Canada, Denmark, France, Germany, Luxembourg, Montenegro, Norway, Poland, United Kingdom, Australia, Austria, Bosnia & Herzegovina, Finland, Ireland, Japan, Moldova, North Macedonia, Serbia, Sweden	USA	21 nations	Yes
Used campaigns to promote recruitment of women	Belgium, Bulgaria, Canada, Denmark, El Salvador, France, Germany, Greece, Latvia, Luxembourg, Montenegro, Netherlands, Poland, Spain, United Kingdom, Australia, Austria, Finland, Ireland, North Macedonia, Serbia	USA	17 nations	Yes
Minimum target goals established for recruitment of women	Albania, Canada, Norway, Australia, Austria, Japan, Moldova		7 nations	Yes
Affirmative action preference to underrepresented gender	Germany, Norway, Austria, Moldova		4 nations	Yes
Female-specific financial aid (e.g., scholarships, grants)	Australia		1 nation	Yes

Physical fitness/physical characteristics requirements regulated to recognize biological differences	Albania, Belgium, Bulgaria, Czech Republic, Croatia, Denmark, El Salvador, France, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Turkey, United Kingdom, Australia, Austria, Bosnia & Herzegovina, Georgia, Ireland, Japan, Moldova, New Zealand, North Macedonia	USA	34 nations	
Selection				
Balanced composition between men and women on selection boards	Spain, Turkey, New Zealand	USA	4 nations	
Evaluation of measures for improving gender balance	Bulgaria, Canada, Czech Republic, Germany, Greece, Spain		6 nations	Yes
Training/Development				
Incorporates gender perspectives in pre-deployment training	Albania, Belgium, Canada, Croatia, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Latvia, Luxembourg, Montenegro, Netherlands, Norway, Poland, Slovenia, Spain, United Kingdom, Australia, Austria, Bosnia & Herzegovina, Finland, Georgia, Ireland, Japan, Moldova, North Macedonia, New Zealand, Serbia, Sweden	USA	33 nations	

Incorporates gender perspective in operational planning	Albania, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Montenegro, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Turkey, United Kingdom, Australia, Austria, Bosnia & Herzegovina, Finland, Georgia, Ireland, Japan, Moldova, North Macedonia, New Zealand, Serbia, Sweden	USA	38 nations	
Retention				
Retention policies specifically targeting women	Albania, Bulgaria, Czech Republic, Germany, Montenegro, Spain, United Kingdom, Japan		8 nations	
Networks to support military women	Belgium, Bulgaria, Canada, Czech Republic, Denmark, France, Germany, Hungary, Montenegro, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, United Kingdom, Bosnia & Herzegovina, Ireland, New Zealand, Sweden	USA	21 nations	Yes
Committee responsible for addressing gender specific issues/barriers	Canada, Czech Republic, Denmark, Germany, Greece, Netherlands, Norway, Spain, New Zealand	USA	10 nations	Yes
Use of gender neutral terms/language	Australia, Canada, United Kingdom		3 nations	Yes
Creation of gender adviser	Albania, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, France, Italy, Luxembourg, Netherlands, Poland, Portugal, Slovenia, Spain, Australia, Austria,	USA	34 member nations	

	Finland, Georgia, Ireland, Japan, New Zealand, North Macedonia, Sweden			
Provided gender advisers with training and education on gender issues	Albania, Belgium, Canada, Czech Republic, Denmark, France, Italy, Luxembourg, Montenegro, Netherlands, Norway, Poland, Portugal, Spain, Austria, Finland, Georgia, Ireland, Japan, Moldova, New Zealand, North Macedonia, Sweden		24 member nations	
Recognize female body differences when procuring equipment/clothing	Canada, Czech Republic, France, Germany, Greece, Norway, Slovenia, United Kingdom, Australia, Austria, Japan, Moldova, Sweden	USA	13 member nations	
Facilities adapted for women and men	Albania, Belgium, Bulgaria, Croatia, Denmark, France, Germany, Luxembourg, Poland, Portugal, Slovenia, Australia, Austria, Bosnia & Herzegovina, Finland, Georgia, Ireland, Japan, Moldova, New Zealand, North Macedonia, Sweden		23 nations	
Maternity leave	Croatia, Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Montenegro, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Turkey, United Kingdom, Australia, Austria, Bosnia & Herzegovina, Finland, Georgia, Ireland, Japan, Moldova, New Zealand, North Macedonia, Serbia, Sweden	USA	34 nations	Yes

Paternity leave	Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Montenegro, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Turkey, United Kingdom, Australia, Austria, Bosnia & Herzegovina, Finland, Georgia, Ireland, Japan, Moldova, New Zealand, North Macedonia, Serbia, Sweden	USA	33 nations	
Transferable parental leave	Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Latvia, Lithuania, Montenegro, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, United Kingdom, Australia, Austria, Finland, Moldova, Ireland, New Zealand, Serbia, Sweden		28 member nations	
Extra weeks of subsidized maternity/paternity leave	Bulgaria, Croatia, Czech Republic, France, Germany, Lithuania, Netherlands, Portugal, Slovenia, Spain, Austria, Japan, Moldova, New Zealand, Serbia		15 nations	Yes
Designated breastfeeding breaks	Albania, Belgium, Canada, Croatia, Czech Republic, France, Germany, Hungary, Italy, Latvia, Luxembourg, Montenegro, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Turkey, Australia, Austria, Georgia, Ireland, Japan, Moldova, New Zealand, North Macedonia	USA	29 nations	

Daycare for children at military installations	Albania, Belgium, Bulgaria, Czech Republic, Germany, Greece, Italy, Netherlands, Norway, Spain, Turkey, United Kingdom, Australia, Japan	USA	15 nations
Flexible work hours/scheduling (e.g., telework, remote work, part-time work)	Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Germany, Hungary, Lithuania, Luxembourg, Montenegro, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Turkey, United Kingdom, Australia, Austria, Finland, Georgia, Japan, Moldova, North Macedonia, Serbia, Sweden	USA	30 nations
Dual-service couples with children are not deployed at the same time	Bulgaria, Czech Republic, France, Germany, Greece, Italy, Luxembourg, Netherlands, Slovakia, Spain, United Kingdom, Australia, Ireland, Sweden		14 nations