Increasing Fighter Pilot Retention with Improved Basing Decisions

This document was submitted as a dissertation in September 2020 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the Pardee RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of Bart Bennett (Chair), Ronald McGarvey, Patrick Mills, and Isaac Opper.
Abstract

The Air Force currently faces a substantial pilot shortage. Two decades of elevated operational tempos, tight budgets, and robust airline hiring have motivated pilots to leave active duty service in record numbers, eroding the Service’s stock of experienced aviators. The global recession caused by the coronavirus pandemic may have temporarily subdued commercial airlines’ demand for military trained pilots, but these conditions won’t last forever, and soon the Air Force will once again need to retain experienced aircrew when the airlines are hiring. This dissertation leverages a value-added model to identify changes to Air Force basing policy that could improve fighter pilot retention outcomes.

Using a value-added model to analyze twenty years of fighter pilot retention data highlights significant variation in retention outcomes at installations across the USAF’s basing posture. Comparing retention outcomes to the communities surrounding military installations can demonstrate pilots’ revealed installation preferences. Investigating recent retention trends at prospective F-35 bases yields insights into the potential retention consequences of future basing decisions.

This dissertation recommends that the Air Force continue to gather as much data as possible about pilots’ personal and professional preferences, so that individuals can be matched with tailored, retention improving assignments. Next, the Air Force should use these preferences to more fully understand pilots’ revealed assignment and installation preferences. Lastly, these preferences should be incorporated into the Air Force’s Strategic Basing Process to move the Service towards a basing posture that passively supports pilot retention with every basing decision.
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Abbreviations

AB  Air Base
AC  Active Component
ACC Air Combat Command
ACTF Aircrew Crisis Task Force
ADSC Additional Duty Service Commitment
AETC Air Education and Training Command
AF  Air Force
AFB Air Force Base
AFI Air Force Instruction
AFMC Air Force Material Command
AFPC Air Force Personnel Center
AFSBP Air Force Strategic Basing Process
AFSBS Air Force Strategic Basing Structure
ATP Arline Transport Pilot
AvB Aviation Bonus
AvIP Aviation Incentive Pay
BAH Basic Allowance for Housing
BAR Basing Action Request
BAS Basic Allowance for Subsistence
BRAC Base Realignment and Closure
BRS Blended Retirement System
CFT Composite Fore Training
CONUS Continental United States
COVID Coronavirus-19
CSI Civilian Simulator Instructor
DCAPES Deliberate Crisis Action Planning and Execution Segments
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
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<tr>
<td>DoD</td>
<td>Department of Defense</td>
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<tr>
<td>FAA</td>
<td>Federal Aviation Administration</td>
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<tr>
<td>FAIP</td>
<td>First Assignment Instructor Pilot</td>
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<tr>
<td>FGO</td>
<td>Field Grade Officer</td>
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<tr>
<td>FTU</td>
<td>Formal Training Unit</td>
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<tr>
<td>GSB</td>
<td>Generalized Boosted Model</td>
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<td>IFF</td>
<td>Introduction to Fighter Fundamentals</td>
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<td>IFT</td>
<td>Initial Flight Training</td>
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<tr>
<td>IP</td>
<td>Instructor Pilot</td>
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<tr>
<td>MDS</td>
<td>Mission Design Series</td>
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<tr>
<td>MilPDS</td>
<td>Military Personnel Data System</td>
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<tr>
<td>NDS</td>
<td>National Defense Strategy</td>
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<tr>
<td>OBOGS</td>
<td>Onboard Oxygen Generation System</td>
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<tr>
<td>OCONUS</td>
<td>Outside the Continental United States</td>
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<tr>
<td>PAA</td>
<td>Primary Aircraft Authorized</td>
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<tr>
<td>PACAF</td>
<td>Pacific Air Forces</td>
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<tr>
<td>PACOM</td>
<td>Pacific Command</td>
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<tr>
<td>PITN</td>
<td>Pilot Instructor Training Next</td>
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<tr>
<td>PMAI</td>
<td>Primary Mission Aircraft Inventory</td>
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<td>PTN</td>
<td>Pilot Training Next</td>
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<td>PTR</td>
<td>Primary Training Range</td>
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<tr>
<td>QoL</td>
<td>Quality of Life</td>
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<td>QoS</td>
<td>Quality of Service</td>
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<tr>
<td>RAF</td>
<td>Royal Air Force</td>
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<td>RAP</td>
<td>Ready Aircrew Program</td>
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<td>RC</td>
<td>Reserve Component</td>
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<tr>
<td>RPA</td>
<td>Remotely Piloted Aircraft</td>
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<tr>
<td>SAASS</td>
<td>School of Advanced Air and Space Studies</td>
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<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>SAFIE/IB</td>
<td>Office of the Assistant Secretary of the Air Force for Installations, Environment and Energy / Strategic Basing</td>
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<tr>
<td>SARS</td>
<td>Severe Acute Respiratory Syndrome</td>
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<tr>
<td>SBESG</td>
<td>Strategic Basing Executive Steering Group</td>
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<tr>
<td>SBP</td>
<td>Strategic Basing Panel</td>
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<tr>
<td>SecAF</td>
<td>Secretary of the Air Force</td>
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<tr>
<td>SERE</td>
<td>Survive, Evade, Resist, Escape</td>
</tr>
<tr>
<td>TDY</td>
<td>Temporary Duty</td>
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<tr>
<td>U.S.</td>
<td>United States</td>
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<tr>
<td>UPT</td>
<td>Undergraduate Pilot Training</td>
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<tr>
<td>USAF</td>
<td>United States Air Force</td>
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<tr>
<td>USAFE-AFAFRICA</td>
<td>United States Air Forces Europe-Air Forces Africa</td>
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<tr>
<td>USEUCOM</td>
<td>Unites States European Command</td>
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<tr>
<td>USINDOPACOM</td>
<td>United States Indo-Pacific Command</td>
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<tr>
<td>UTE</td>
<td>Utilization Rate</td>
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<td>VAM</td>
<td>Value-Added Model</td>
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<tr>
<td>YAS</td>
<td>Years Aviation Service</td>
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<td>YOS</td>
<td>Years of Service</td>
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1. Introduction

The United States Air Force (USAF) cannot fulfill its mission to “win in air, space and cyberspace” without fighter pilots (USAF, 2020). However, maintaining healthy fighter communities is challenging when operations tempos are high, budgets are tight, and the commercial airlines are hiring. This dissertation will strengthen the Air Force’s ability to fulfill its mission in support of the National Security Strategy by investigating the relationship between where pilots are stationed and their retention decisions.

The Air Force currently faces a large pilot shortage. In 2020 Air Force Chief of Staff David L. Goldfein testified to the House Armed Services Committee that the Service lacked 2,000 of the roughly 21,000 pilots it needs (Full Committee Hearing: “The Fiscal Year 2021 National Defense Authorization Budget Request for the Department of the Air Force”, 2020). Two decades of elevated operational tempos and hiring surges from major commercial airlines depleted the Service’s stock of experienced aviators (Mattock and Asch, 2019). Despite years of effort to increase retention following Gen Goldfein and Secretary James public recognition of the shortfall in 2016, the shortage continued to grow through 2019. In the presence of a strong global economy and expanding aviation industry it appeared the Air Force’s traditional strategies to increase retention were insufficient. The Service needed novel solutions to reverse dangerous retention trends.

The global economic recession caused by the novel coronavirus (COVID) has changed the retention landscape dramatically. Unemployment has risen and major commercial airlines have seen their global expansion reverse into a sweeping recession overnight. Airlines have dramatically decreased their operations, are furloughing pilots, and have implemented hiring freezes (Josephs, 2020). This may temporarily improve pilot retention, providing an opportunity to decrease the shortage. But the Service has also incorporated virus transmission mitigating changes to its production capacity, limiting its ability to produce pilots. The size of pilot training cohorts has decreased and the pace of their training has slowed in order to protect students, instructors and support personnel at pilot training bases (Dickstein, 2020). As a result, the Air Force will not meet its pilot production goal for 2020 (Pawlyk, 2020).

At the same time, the economic recession caused by the virus will likely have budgetary consequences for the Department of Defense (DoD). In response to expanding deficits following the U.S. Government’s response to the Great Recession, the DoD saw budgets shrink by $500 billion over the next ten years. Assuming the DoD budget remains fixed as its current percentage of GDP, 3.2%, the DoD could expect to see its budgets decreased by between $350 billion and $600 billion over the next ten years, depending on the speed of the economic recovery. Decreasing funding would further constrain the Air Force’s ability to produce, absorb and retain pilots (Egel et al., 2020).
Although the timeline and magnitude of the economic recovery are uncertain, air travel and freight patterns will likely eventually return to their pre-COVID levels. This has been the case following previous shocks to the commercial aviation industry. Following the terrorist attacks of September 11th in the United States, the Severe Acute Respiratory Syndrome (SARS) pandemic in 2003, and the Great Recession, demand for air travel faltered in the immediate aftermath of the shock, but rebounded to pre-crisis levels within a few years (Notis, 2017). When global demand returns the Air Force will once again need a new solution to an old problem: how to retain enough experienced fighter pilots when the airlines are hiring. This dissertation will investigate the potential utility of leveraging the Air Force’s basing posture to increase pilot retention.

Origins of the Current Pilot Shortage

To ensure the Air Force remains staffed with the appropriate quantities of all types of pilots the Service monitors the aircrew management pipeline. This framework encompasses three components: pilot production, absorption and retention. Each segment is equally important, and the flow of pilots through each phase must be balanced to ensure aircrew communities are fully staffed with pilots of all experience levels. Following the end of the Cold War, the USAF underwent a massive drawdown that limited production and absorption capacity. The drawdown decreased USAF manpower end strength which greatly reduced the number of pilot positions, and decreased the total number of flying units. The active component endured a 48% decrease in the primary mission aircraft inventory (PMAI) (Taylor, Bigelow and Ausink, 2009). With fewer line aircraft on the tarmac, fewer sorties could be flown each day. This reality was felt most severely by junior pilots, who needed to fly frequently in order to promptly complete their training objectives. With a decreased stock of aircraft, the service could not absorb as many new fighter pilots. The scarcity of training sorties increases the challenge for new fighter pilots to fly 500 training hours, and officially be recognized as “experienced” pilots.¹

The post-Cold War drawdown also motivated the closure of one of the service’s four primary pilot training bases (Taylor, Bigelow and Ausink, 2009).² The Air Force closed Williams AFB in 1993, decreasing the USAF’s pilot production capability. With only three undergraduate pilot training (UPT) bases remaining, the USAF simply could not produce as many pilots per year as it could during the Cold War.

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¹ The Air Force’s plan for fighter pilot career development expects that inexperienced pilots (those with less than 500 flight hours) will be seasoned into experienced pilots (pilots with over 500 flight hours) during their first assignment. This allows them to fill any of the myriad roles experienced pilots are qualified for at their second assignment.

² A small number of Air Force pilots also participate in flight training as a part of the Euro-NATO Joint Jet Pilot Training (ENJPT) at Sheppard AFB.
In addition to the reduced number of cockpits available to produce and absorb new pilots, declining utilization (UTE) rates also limit the current USAF’s ability to increase pilot absorption (Taylor, Bigelow and Ausink, 2009). The average age of an F-15C is now 35 years, and the average age of an F-16 is 29 years (Air Force Magazine, 2019). Aging aircraft break down more frequently, limiting the number of aircraft available to support training missions at any given time. Less available aircraft further constrains the Air Force’s ability to absorb fighter pilots.

Operating this fleet of fatigued aircraft is a corps of fatigued airmen (Carson, 2017). Two decades of fighting in the Middle East compounded by manpower limiting tight budgets have strained USAF pilots and pushed many out of the service. This sentiment is evidenced by a 2009 re-vamp of the “Dear Boss” letter first made famous by Captain Ron Key in the 1970s (Anderegg, 2001). Here an exhausted F-15 pilot bemoans an Air Force that no longer prioritizes flying, and overburdens its pilots with additional duties such as administrative functions, paperwork, surveys and computer based trainings. A service that promotes leaders who have completed the right career milestones over those who boast quality leadership skills (Stahl, 2014). The author asserts that these circumstances lead good officers to separate.

The production, absorption and retention stressors discussed above independently concern aircrew managers. Experiencing them all at the same time could stress the system beyond its breaking point. COVID may have temporarily alleviated some retention concerns, but has also decreased the Service’s production capabilities. Moreover, COVID’s consequences will likely be temporary, and following their dissolution the Air Force will once again be forced to produce, absorb and retain pilots in a tight labor market. Returning healthy balance to the pipeline will require multiple policy interventions. And, likely interventions that go beyond the Air Force’s traditional response to aircrew shortages.

Historically the Air Force has responded to pilot shortages by increasing pilot compensation (Mattock et al., 2016). The Service attempts to increase retention by closing the pay gap between pilots’ expected earnings in the Air Force and the commercial airlines. Considering the high correlation between airline hiring and military pilot retention rates, this is a valid strategy (McGee, 2015). Recently the literature has started to include increasing pilot quality of life (QoL) and quality of service (QoS) as a viable path to increase pilot retention. Proponents of this strategy have historically been uniformed scholars, many completing their Air Command and Staff College thesis. Recently their ideas have gained traction among Service leadership. Gen Goldfein’s initiative to revitalize Air Force squadrons and the Secretary of the Air Force’s commitment to include military family support in the Strategic Basing Process are two examples of policies that prioritize pilot QoL and QoS (Barnett, 2018; Affairs, 2020). Proponents of this analysis suggest that increasing pilot quality of life and quality of service is the most effective way to combat the deep pockets of the commercial aviation industry. They

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3 See Stahl, Mintz, and Carson.
advocate that the Air Force could do more to increase retention by improving pilots’ experience in the Air Force than increasing their pay.

This relatively new vein of analysis has to-date neglected the role basing plays on retention. Many quality of life determining factors are a function of the installation and community where pilots and their families work and live. Placing pilots at installations and in communities where they are most likely to experience high qualities of life and service is a currently unstudied solution.

However, pilot retention is not the primary driver of basing decisions. Mission, capacity, environmental, cost and political considerations have historically dominated basing decisions. In an ideal world the Air Force could adjust its basing posture as its needs and priorities change. However, installations’ have substantial economic impacts on their surrounding communities. And as a result, potential reductions at the base or complete closures encounter fierce political resistance. As a result, most major changes to the USAFs basing posture since the end of the Cold War have been conducted under the Base Realignment and Closure Act (BRAC) legislation. However, despite numerous requests from the DoD and the executive branch, Congress has not initiated a BRAC since 2005 (Principi, 2015). Despite the cost savings and efficiency improvements that the DoD asserts would result from certain closures and reorganizations, the political cost of doing so has prevented Congress from ordering a DoD-wide basing review. As a result the Air Force and its sister services continue to operate unneeded and costly excess infrastructure (Principi, 2015).

Standing up new F-35 squadrons will give the USAF the unique ability to alter its basing posture outside of a BRAC. As the Air Force incorporates the F-35 into its ranks over the coming years it will create new squadrons to host the new aircraft or convert existing squadrons into F-35 squadrons. Both actions necessitate the completion of the Air Force’s Strategic Basing Process (AFSBP) to determine where the new units will be stationed. By including pilot retention considerations into the AFSBP the Air Force could leverage its basing posture to affect pilot retention for years to come.

Objective and Scope

This dissertation will improve the Air Force’s understanding of the relationship between where pilots are stationed and their retention decisions. Such an understanding could allow the Air Force to address pilot retention, a pressing enterprise-wide strategic interest, in basing decisions. It will also yield unique insights into how the Air Force’s new Supporting Military Families initiative could affect fighter pilot retention. This dissertation will pursue these objectives by answering the following research questions:

4 These basing decisions will not involve “closing” installations, but rather determining which installations will receive F-35s, and in what order.
1. Historically, have basing locations affected pilots’ retention decisions?
2. How are installations and the communities that surround them related to retention outcomes?
3. How can these findings be used to better inform the basing site selection of new F-35 squadrons?

This dissertation will address the first research question by analyzing all fighter pilot retention decisions made by officers ranking O-3 to O-5 from 2000-2019. Each installation’s contribution to the likelihood that a pilot is retained while making a retention decision at that installation will be estimated using a value-added model adapted from education and healthcare research. The second research question will be answered by comparing estimated installation-effects to Quality of Life enhancing community descriptors identified in the Air Forces Supporting Military Families initiative. Lastly, this dissertation will pursue the third research question by analyzing the installation-effects of installations transitioning from 4th to 5th generation fighter aircraft, and prospective F-35 installations in greater detail.

This research is limited to studying the retention behavior of active duty fighter pilots stationed at bases operating active duty squadrons. Undoubtedly many of the same methods could be applied to all types of pilots serving in other capacities.

Organization

This dissertation contains seven chapters. The present introduces readers to the aircrew shortage, its origins, and possible resolution strategies. The second will introduce the fundamentals of aircrew management, dive deeper into the current status of the Air Force’s pilot shortage, discuss the Service’s initiative to eliminate the shortage, and survey relevant military pilot retention scholarship. The third will introduce readers to the Air Force’s basing posture, the policies governing its basing decisions, and an outline of future decisions. The fourth chapter introduces value added modeling and details this dissertation’s application of the method. The fifth chapter demonstrates an application of a novel value-added model capable of estimating installations’ effects on pilot retention and identifying potential improvements to Air Force retention policy. The sixth chapter discusses how the creation of new F-35 squadrons provides the Air Force with a unique opportunity to adjust its basing posture outside of a BRAC and demonstrates how the value-added model introduced in this dissertation can be used to inform these decisions. The seventh chapter concludes, offers recommendations to the Air Force and highlights future opportunities for research.
The Air Force relies on successful aircrew management to maintain a cadre of fighter pilots. These practices ensure the service maintains the appropriate quantity of competent pilots across the experience distribution needed to fulfil its mission. This chapter first introduces the mechanics of aircrew management, and then describes the current status of the Air Force’s pilot shortage and ongoing mitigation efforts. The final section explores scholarship that informed the Air Force’s strategies to improve pilot retention.

Aircrew Management 101

Aircrew management attempts to develop cohorts of pilots that will adequately fill Air Force positions requiring the skills and experience of rated officers. It begins with the accession and initial training of prospective pilots, continues at their first assignment in or to accumulate sufficient flight hours, and then carries on throughout a pilot’s career. This section examines each of these phases in detail.

Production

The production phase of the aircrew management pipeline begins when a pilot trainee receives their commission. After a brief waiting period the trainee will complete Initial Flight Training (IFT), and then begin UPT after another brief wait. Upon the completion of UPT, trainees receive their wings and their next assignment. If trainees are selected to be fighter pilots, they will complete another training battery consisting of Introduction to Fighter Fundamentals (IFF), Survive, Evade, Resist and Escape (SERE) training, as well as mission design series (MDS) specific instruction at a Formal Training Unit (FTU). After successfully completing each step of the production phase, a newly minted pilot will transition into their first operational squadron. Figure 2.1 illustrates a sample timeline the training pilot trainees complete before arriving at their first operational assignment (Taylor et al., 2002).
Absorption

Absorption is the process through which an inexperienced pilot is seasoned into an experienced pilot. To be absorbed pilots must build the flying and non-flying skills needed to succeed in future assignments. For managerial purposes the Air Force assumes this transition takes place after fighter pilots have accrued 500 hours in their primary aircraft.\(^5\) Pilots with less than 500 flight hours are classified as inexperienced, while those boasting more than 500 flight hours are labeled experienced. Experienced pilots are eligible to upgrade to flight leadership positions such as aircraft commander, flight lead, or instructor (Taylor, Bigelow and Ausink, 2009).\(^6\)

Absorption capacity is the number of pilots that can be annually absorbed into a unit. It is driven by each unit’s training capacity, which is defined by the number of training sorties that unit can generate each year. The number of training sorties available depends on unit manning levels, aircraft inventory, and UTE rates. One of the key challenges affecting absorption is that most training sorties for inexperienced pilots must include an experienced pilot because most inexperienced pilots are only qualified to fly as wingmen. Units must be appropriately balanced between experienced and inexperienced pilots so that each group is able to fly the training sorties required for their respective upgrades (Taylor, Bigelow and Ausink, 2009).

The rate at which inexperienced pilots accrue flying hours is known as their aging rate. This rate is measured in terms of flight time, therefore depends on both the quantity and duration of training sorties pilots receive. This rate matters because the Air Force would like all inexperienced pilots to become experienced during their first 3-year operational assignment (Taylor, Bigelow and Ausink, 2009).

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\(^5\) The experiences needed to become an “experienced” fighter pilot are hotly debated. Nonetheless, the Air Force deemed 500 hours sufficient and continues to use this benchmark.

\(^6\) Exceptions are made for pilots who are already qualified to fly another aircraft.
The Air Force’s production and absorption rates work together to ensure the efficient production of fully mission qualified pilots. If either phase outpaces the other, proficiency limiting delays develop in the system. Inexperienced pilots need to fly frequently and regularly to build proficiency. If the Air Force produces more pilots than can absorb, pilots could be delayed in their completion of FTU training, or experience too low aging rates at their first operational assignments. Both conditions limit the development of individual aviators and the combat capability of the entire enterprise (Taylor et al., 2002).

**Retention**

Retention is the final phase of the aircrew management pipeline. Upon the completion of UPT, pilots incur a ten-year additional duty service commitment (ADSC). After completing this service obligation most pilots are eligible to make their first retention decision; choosing to continue their active duty careers, affiliate with the reserve component, or separate from military service. Ensuring proper quantities of experienced aviators remain on active duty is a paramount concern for the Air Force because these aviators have the expertise needed in senior flying, training, leadership and staff positions (Robbert et al., 2015).

Retention is a particularly challenging component of the aircrew management pipeline because the primary driver of separations is outside the Air Force’s control: civilian airline hiring. Historical analysis of pilot retention and airline hiring data shows that when the civilian airlines are hiring, military aviators separate from active duty service in droves. The Air Force offers pilots two additional types of compensation to decrease the wage gap between military service and flying for the commercial airlines. These additional compensation strategies will be discussed further in the next section (Sweeney, 2015).

To maintain healthy aircrew communities, each phase of the aircrew management pipeline must be in balance. Long run production and absorption need to be greater than total demand, and production should not exceed absorption. Retention must be high enough to meet the demand for senior (field grade officer (FGO) and above) pilots (Robbert et al., 2015). The next section will discuss the status of the current pilot shortage, as well as the mitigation efforts the Air Force is taking to eradicate its pilot shortage.

**The Current State of the Air Force’s Pilot Shortage**

In a March 4th, 2020 testimony to House Armed Services Committee General David Goldfein, USAF Chief of Staff, testified that his service is currently “holding its own” regarding its pilot shortage. General Goldfein noted that the Air Force ended 2019 about 2,000 pilots short of the 21,000 it needs across the total force to execute its mission (Full Committee Hearing: “The

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7 Pilots who incur additional ADSCs before the completion of their UPT ADSC may not be eligible to separate 10 years after their graduation from UPT. These aviators would be eligible to do so after the fulfillment of their most outstanding ADSC.
Fiscal Year 2021 National Defense Authorization Budget Request for the Department of the Air Force”, 2020). The shortage is most acute with fighter pilots, with nearly half of the Air Force’s 2,000 pilot shortfall being fighter pilots (OUSD, 2019). Subsequent subsections will discuss the current status of each phase of the aircrew management pipeline and the changes the Air Force is making to address the overall shortage.

Production

In the same address to the House Armed Services Committee, Gen. Goldfein and Sec. Barrett testify that the current pilot shortage extends beyond the USAF and is a national problem. They assert that United States as a whole is not producing enough pilots to meet its civilian or military demand (Full Committee Hearing: “The Fiscal Year 2021 National Defense Authorization Budget Request for the Department of the Air Force”, 2020). The increasing cost and time required to receive a Federal Aviation Administration (FAA) restricted privileges Airline Transport Pilot (ATP) Certificate has limited the number of civilian pilots available for employment with the commercial airlines. Meanwhile, the Air Forces current size (personnel and aircraft) and aging fleet of training aircraft have also suppressed the Air Force’s ability to produce military aviators (OUSD, 2019).

Increasing its pilot production capability is a key element in the Air Force’s plan to eradicate the pilot shortage. The Service believes that leveraging a syllabus consolidation, Pilot Training Next (PTN), and Pilot Instructor Training Next (PITN) will enable the production of historic quantities of pilots in the next five years. With these innovations, Air Education and Training Command believes they can produce 1480 pilots per year. This estimate is contingent upon instructor pilot (IP) and civilian simulator instructor (CSI) manning, no unexpected training delays, and required maintenance sortie generation. However, these very complications have limited USAF production in recent years (OUSD, 2019).

Maj. Gen. Jake Jacobsen, director of the Aircrew Crisis Task Force, reports that maintenance issues, instructor shortages, and COVID-19 have limited the Air Force’s pilot production in 2019 and 2020 (Losey, 2020). In 2019, three classes of UPT students were delayed due to issues with the T-6’s on-board oxygen generation system (OBOGS). IP shortages caused AF/A3 to approve the addition of 50 additional first assignment instructor pilots (FAIPs) to cover shortfalls (Wills, 2019). And hail damage, routine maintenance, and the unavailability of replacement parts demonstrated the age of the training fleet. Although these specific instances occurred in 2019, similar disruptions in the training pipeline can be expected to happen every year.

Although UPT students receive the majority of their instruction from uniformed IPs, CSIs also contribute to students’ education via formal instruction during many of students’ simulator sorties. Their presence allows students to receive quality instruction during simulator rides, while allowing the limited number of uniformed IPs to focus on flight line operations. CSIs are a critical component of the training environment but are becoming a scarce resource. As of November 2019, only 71% of CSI positions were filled. To make matters worse, 85% of CSIs
are over 50 years old, and 44% are currently eligible for retirement. An essential component of the production pipeline could experience a critical manning shortfall, should a large number of retirement-eligible employees decide to retire together (Wills, 2019).

The global pandemic caused by the outbreak of a novel coronavirus has also limited the Air Force’s production of new pilots. According to General Brad Webb, the Air Force’s training chief, COVID has forced the Air Force to decrease the size of UPT classes and limit the amount of time trainees spend in the cockpit. To reduce training bases’ vulnerability to outbreaks, UPT students have been divided into small groups of seven to eight students, only interact with one another and their instructors, and take shifts getting flying time. Although the long-term consequences of the pandemic on the pilot shortage are unclear the virus is limiting USAF pilot production in the near-term (Dickstein, 2020).

To overcome these familiar complications and meet its lofty 1480 annual pilot production goal, the Air Force is leveraging training syllabus optimizations, lessons learned from PTN, and lessons learned from PITN. The redesigned UPT syllabus improves training quality and better aligns with FTU absorption while shortening the program by an average of five to nine weeks per student pilot. Applied at each UPT installation, these changes increased the production phases maximum output from 1400 to 1480 pilot annually (OUSD, 2019).

PTN is a part of Air Education and Training Command’s (AETC) initiative to improve how they deliver training to Airmen. PTN leverages virtual reality, artificial intelligence and data analytics to improve student pilot outcomes while decreasing training costs and timelines (AETC, 2020). Student pilots selected to train under the PTN curriculum instead of the traditional UPT curriculum fly 80-90 formal flying hours in simulators and 70-80 hours in the T-6 Texan II in addition to sim flying done in their personal time (Hawkins, 2018). One key tenant of PTN is that students are given their own flight simulator which they keep in their home and can use at any hour of the day. Air Education and Training Command (AETC) hopes that continual access to training materials, remote instruction, and continual data gathering/analysis will allow students to progress through training more quickly and with a deeper understanding of the material. ³ Maj Gen Wills estimated that lessons learned from PTN applied to UPT could create a 15-20% increase in production capacity by 2024 (Wills, 2019).

PITN incorporates similar technologies to improve instructor pilot training. Instructor pilots use virtual-reality simulators complete with 360-degree video headsets to improve their training. These technologies allow student pilots and instructors to be tested in high-stress environments without incurring the cost or risk traditionally required to put them in such situations. All of these efforts combine to produce what AETC describes as the “Mach-21” airman, or the next generation of twenty-first century pilots (Pawlyk, 2018).

³ AETC expects that AI flight instructors will eventually be included in students’ take-home training materials.
Absorption

Sortie generation is a key component of the Air Force’s ability to absorb pilots. At their first operational assignments junior aviators build proficiency by logging an abundance of flight hours in high quality training sorties with expert instructors. This type of training requires access to a fleet of mission-ready aircraft and a cadre of experienced instructors. Many of the same factors inhibiting USAF pilot production also stymie the Service’s ability absorb inexperienced aviators. Limited numbers of cockpits and the low mission-readiness rates exhibiting by aging aircraft limit operational squadrons’ ability to generate the number/type of sorties needed to mature inexperienced aviators. Simultaneously, shortages of experienced instructor pilots further constrain the Air Force’s ability to provide high-quality training to newly minted fighter pilots. Increasing absorption to balance increased production will require a concert of policy initiatives (OUSD, 2019).

The production improving solutions described in the last section will also increase the Air Force’s absorption capability. The Aircrew Crisis Task Force (ACTF’s) optimizations of the UPT curriculum will streamline the flow of new pilots through UPT and FTUs with the goal of maximizing annual production. The same efficiency that maximizes annual production also streamlines the arrival of FTU graduates to their first operational assignments. Preventing gluts of inexperienced pilots from developing in operational squadrons preserves the experience ratios needed to guarantee inexperienced aviators access to experienced instructors.

While the Air Force revamps its supply of instructor pilots, especially fighter pilots, the Active Component (AC) fighter enterprise will rely increasingly on Reserve Component (RC) assets to absorb new fighter pilots. RC units are rich in exactly the type of expertise AC units need to facilitate the maturation of their newest pilots. By sending FTU graduates for their initial assignments with RC units, the AC can capitalize on their additional resources in terms of both aircraft and experienced instructors (Full Committee Hearing: “The Fiscal Year 2021 National Defense Authorization Budget Request for the Department of the Air Force”, 2020).

Increasing retention will also be a critical component of restoring the AC with the expertise it needs to absorb new aviators. The Air Force’s plan to do so will be discussed in the next section, but as retention increases, the experience levels of AC squadrons increase in turn. With more experienced pilots, AC squadrons can generate more of the training sorties inexperienced pilots need.

Retention

In July, 2016 Secretary of the Air Force Debora Lee James and Gen. Goldfein penned a joint op-ed recognizing the plights of many pilots. They acknowledged that pilots were burnt-out after a decade of counterinsurgency operations amidst widespread budget-cuts and pledged to improve their situations. The Secretary and Chief noted that a booming economy and rapidly expanding
global airline industry complicated the task of retaining military aviators, but maintained that increasing pilot compensation and quality of life was a priority for the Air Force (James and Goldfein, 2016).

Since 2016 the Air Force has pursued numerous retention improving policy changes. In 2017 Congress increased the maximum cap on AviatAvIP from $840 per month to $1,000 per month, and the AvB pay cap from $25,000 per year to $35,000 per year (SAF, 2017). The AvB cap had not changed since 1999 and was less than the $48,000 requested by James. The change in value has yet to demonstrate a meaningful decrease in experienced pilot attrition to date (OUSD, 2019).

Many initiatives to increase pilots’ quality of service have manifested under Gen. Goldfein’s commitment to revitalize squadrons. In August of 2016 Gen. Goldfein announced that one of his top priorities was to “revitalize the squadron as the warfighting core of… [the] Air Force” (Goldfein, 2016). This effort began with the establishment of an assigned task force created to identify and implement visible improvements across the Air Force. Goldfein’s task force conducted a force wide review involving “on-line crowd sourcing and face-to-face discussions with nearly 4,000 individuals, including spouses, from 25 different bases representing all major commands, Reserve and National Guard.” The task force’s engagements with Airmen identified improvements, best practices and enabled the completion of a comprehensive model for squadron vitality. Equipped with this model the task force has implemented meaningful changes via three major lines of effort: focusing on the mission, strengthening leadership and culture, and taking care of Airmen and Families (Barnett, 2018).

To allow pilots to focus on the mission the Air Force committed to identifying and eliminating non-essential training, additional duties unrelated to the flying mission, and administrative duties. Pilots have repeatedly highlighted these responsibilities as distractions that not only limit their proficiency as aviators, but also erode their qualities of life and service by inflating operations tempos and distorting coveted work/life balance. Additional administrative personnel have been returned squadrons to carry-out these administrative functions while allowing aviators to focus on flying (OUSD, 2019).

The Air Force is also modifying the assignment system to increase pilots’ agency in charting their own careers. Many of these changes are evident in the Air Force’s new assignment platform for officers, The Talent Marketplace. This platform increases the transparency of available assignments, the visibility officer preferences, and incorporating gaining commander input into the assignment process. The Air Force believes offering officers more control over their assignments will increase the quality of life for pilots and their families (Bailey, 2019).

Another effort to increase pilot quality of life exists under the Air Force’s Supporting Military Families initiative. In 2018, the Secretaries of the Army, Navy and Air Force penned a joint letter to the National Governors Association asking state governors to consider supporting legislation that would increase reciprocity of professional licensure for military families and the quality of schools near military installations. The Secretaries reference difficulties assimilating
into new school districts and maintaining professional licenses during PCSs as commonly cited drawbacks to military service, and ask for Governors help in resolving these issues at the state level (Spencer, Esper and Wilson, 2018).

In February 2020 the Air Force announced its approval of criteria that will incorporate professional licensure and local school considerations into the Strategic Basing Process. These criteria will “assess states’ policies for accepting professional, career licenses and a community’s public education system support of military children.” The addition of these criteria seeks to increase pilot quality of life by incentivizing communities to support the unique needs of families who relocate frequently (Affairs, 2020).

The Origins of the Air Force’s Multifaceted Pilot Retention Strategy

The remainder of this dissertation will focus on the retention phase of the aircrew management pipeline. The Air Force’s willingness to address pilot retention shortfalls with a multifaceted retention strategy is a relatively new phenomena, and this section will explore scholarship that informed the Air Force’s pilot retention paradigm. This section will discuss the Air Force’s proposed solutions and the philosophy motivating them in two primary categories: monetary and non-monetary.

Monetary

The Air Force’s traditional tool to increase pilot retention is additional compensation. In 2016, Michael Mattock and his team’s work “Retaining U.S. Air Force Pilots When the Civilian Demand for Pilots is Growing” analyzes how the USAF can leverage aviator retention pay (ARP) and aviator pay (AP) to increase pilot retention. The authors assert that military pilots will be in higher demand by civilian airlines as baby boomers retire and the FAA increases the requirements to receive a commercial rating. Mattock’s work forecasts future pilot demand, expands the analytic methodology in the RAND dynamic retention model, and simulates a variety of situations to understand how ARP and AP could be used to combat increasing opportunities for civilian employment (Mattock et al., 2016).

To forecast future pilot demand, they examine trends in total passenger miles flown, total freight miles flown, aircraft size and load capacity. They conclude that increasing demand for passenger and freight miles will increase the demand for pilots, but these upticks will be partially offset by the increasing size and load capacity of future aircraft. The net result will be a moderate increase in demand for civilian pilots (Mattock et al., 2016).

Mattock’s team expands the RAND dynamic retention model by employing data from 1990-2012, developing a new way to model the uncertainty underlying pilots’ choice to enter a multi-year contract following the completion of their initial service commitment, and allowing the model to recognize multiple entry cohorts. These changes allow the team to simulate pilot retention under a host of different demand and compensation scenarios (Mattock et al., 2016).
They find that a significant increase in hiring from civilian airlines will negatively affect USAF pilot retention. They estimate that an increase in hiring from 1700 to 3200 pilots annually correlates with an increase in the likelihood that a separation-eligible military pilot will be hired from 10 percent to 50 percent, and a decrease the steady-state pilot stock by 6.3% (800 pilots). Likewise, an increase in the wage offered by major airlines will negatively affect pilot retention. Mattock’s analysis shows that an increase in civilian pilot pay of 12% in addition to an increase in hiring could decrease the steady state pilot force by 12.3%, or 1587 pilots. The report recommends increasing the ARP cap from its, then, current level of $25,000 to between $38,500 and $62,500 (Mattock et al., 2016).

In 2017 the Air Force and Congress acted in accord with these findings, and increased monthly aviation incentive pay (AvIP) from a maximum of $840 per month to a maximum of $1000 per month, and the cap for annual pilot bonuses from $25,000 to $35,000. However, Congress did not increase the cap for annual pilot bonuses as high as the Air Force had requested. In 2019, among continued poor pilot retention outcomes, the Air Force commissioned another study investigating the efficacy of retaining pilots with financial incentives. In their 2019 piece “The Relative Cost-Effectiveness of Retaining Versus Accessing Air Force Pilots” Michael Mattock, Beth Asch, James Hosek, and Michael Boito determine that it is more cost efficient to retain pilots than to access and train new ones. First, their team estimates the total cost of creating new pilots of various types by totaling the cost per flight hour totals for IFT, UPT, IFF and FTU training for all MDSs. They then compare that figure to the costs of increasing the Aviation Bonus (AvB). They find that the exorbitant cost of creating USAF pilots renders increasing AvB pay to as much as $95,000 per year fiscally responsible (Mattock et al., 2019).

Mattock and his team use the DRM to simulate the effect of changing the AvB pay from $0-$95,000 on retention decisions, and ultimately per capita pilot costs. They find that retention increases as AvB increases, with the first $40,000 increase being most effective. Beyond $40,000, the majority of servicemembers with reasonable proclivities to remain in the service have already decided to recommit, and capturing the remaining holdouts requires considerable additional investment. They found that for all MDS, increasing AvB up to $95,000 is more cost efficient than accessing new pilots. Doing so will also likely lead to a more experienced fighter pilot corps, a positive externality (Mattock et al., 2019).

These pieces of analysis and others like them underpin the Air Forces traditionally compensation-centric retention strategies. They assert that the most powerful driver of military pilot separations is airline hiring, and the best way to increase retention is with additional compensation. Lingering low retention outcomes amidst after increasing AvIP and AvB in 2017 have motivated the Air Force to consider alternative retention strategies. The following subsection will survey the literature motivating some of the most prominent potential solutions.
Non-monetary

Most of the Air Force’s non-monetary strategies to increase pilot retention expect to do so by increasing pilots’ and their family’s qualities of life and service. Increasing retention in this manner has long been popular among uniformed scholars but has only recently become a palatable policy solution among decisionmakers in the Pentagon. In his 2014 School of Advanced Air and Space Studies (SAASS) thesis “Clinging to the Past: The Air Force's War on Dual-Career Families,” now Maj. John Paul Mintz argues that many Air Force norms and expectations regarding family mobility and spousal participation in military culture are outdated and out of touch with modern military families. He claims that these institutional identities are particularly stressful on dual-income families. The hypermobility normalized within the USAF devastates spouses’ ability to advance their own careers. Major Mintz goes even further by asserting that these stresses are strong enough to motivate premature separation from the Air Force (Mintz, 2014).

Mintz roots his assertions in an original case study and focus group that he believes represent sentiments held throughout the force. He recommends that the Air Force seriously consider curbing its insistence on hypermobility, or at a minimum give airmen more control over their next assignments. Mintz continues to recommend that the service take effort to realign its culture with its families by refusing to insinuate spousal participation in unit events, ceasing to use the term “dependent,” and generally viewing spousal careers as an important manifestation of the service’s commitment to “put people first” (Mintz, 2014).

In 2015 Lt Col Brain Stahl published his Drew Award winning SAASS thesis titled “Blunting the Spear: Why Good People Get Out.” He examines pilot retention by analyzing rated-officer retention reports, original survey data and interviews to better understand why pilots separate. He found that the lack of meaningful exit and retention surveys issued throughout an officer’s career left the Air Force with an incomplete picture of what matters to aircrew, and significantly curbs their ability to increase retention (Stahl, 2014).

Stahl engaged with three types of aircrew: fighter pilots, bomber pilots and remotely piloted aircraft (RPA) pilots. In addition to interviews he conducted a survey that asked pilots about the most important variables they consider when making retention decisions. Stahl found that each group believed operations tempo and family stability were the two most important contributors to their retention decisions. These variables outperformed “air force identity,” “money and compensation,” “promotion and recognition,” as well as “other life goals.” His work documents the complexity and breadth of factors aircrew consider when making retention decisions. It supports the idea that pilot retention is not an issue that will likely be resolved by bonuses alone (Stahl, 2014).

In 2017, LtCol Chris Carson continues this vein of the literature by exploring the humanistic factors contributing to decreased pilot retention in his dissertation, “I Hear What you Are Saying.” Carson performs a text analysis on pilots’ open-ended responses from the 2015 Active
Duty Career Decisions Survey. He argues that compensation is one of many important factors pilots consider when making retention decisions, and urges analysts to study the humanistic factors pushing pilots out of the services with the same fervor currently devoted to studying compensation based retention strategies (Carson, 2017).

Carson’s dissertation begins with a literature review focusing on turnover dynamics in the civilian workplace. He identifies popular turnover models and assesses their applicability to the military setting. He then executes a word frequency analysis and theme analysis on his open-ended survey responses. He looks for trends in respondents’ answers based on 3 different indicators: pilot type, separation intentions, retirement intentions (Carson, 2017).

The author finds that there is no meaningful distinction between how different types of pilots responded to the same questions. He asserts that this attests to relatively uniform group of pilots that should be catered to as one body, rather than independent factions. After looking at his research questions from three different paradigms, Carson concluded that those who intend to separate from the Air Force do so out of frustration with additional duties, leadership, deployments, and quality of life issues; not money. Conversely, pilots who intend to remain in the service do so out of admiration for what they do and who they do it with; not money. By focusing so heavily on setting the bonus to retain an appropriate quantity of utility maximizers, retention analysts overlook what pilots are telling them drive their retention decisions (Carson, 2017). These types of arguments are the foundation of many non-monetary retention improvement plans.

Summary

The Air Force must maintain a cadre of trained and equipped pilots of all experience levels in order to successfully fulfill its mission outlined in the 2018 National Defense Strategy. Doing so requires the Air Force to produce, absorb and retain appropriate quantities of pilots each year. This task is complicated by a personnel system that does not allow lateral accessions and a civilian airline industry ready to employ military aviators. In continuing to seek resolutions to the current pilot shortage the Air Force must leverage best practices highlighted by completed research and continue to pursue new strategies with future analysis.

The existing literature emphasizes the importance of simultaneously balancing the three phases of the aircrew management pipeline: production, absorption, and retention. A balanced pipeline is one where long-run production and absorption are greater than total demand, production does not exceed absorption, and retention is sufficient to meet the demand for senior (O-4 and above) pilots (Robbert et al., 2015). Many analysts have documented the unique relationship between the civilian airlines and the Air Force. The Air Force invests millions of dollars to train and season military aviators, but its retention efforts are at the mercy of major airlines hiring practices. When the airlines are hiring, pilots leave the Air Force for civilian careers (Sweeney, 2015). Moreover the airlines are not inclined to work together with the Air
Force, as they have the most to lose and little motivation for negotiating to improve the Air Force’s situation (Rosello et al., 2016).

The literature is rich with recommendations as to how the Air Force can close the pilot shortage. The literature suggests that the Air Force should increase pilot compensation, namely the Aviation Bonus (AvB), to be more competitive with commercial airline salaries (Mattock et al., 2019). Recently the literature has started to include investigations of increasing pilot quality of life as a viable path to increase pilot retention. Proponents of this strategy have historically been uniformed scholars, many completing their Air Command and Staff College thesis, but is now starting to gain traction among Service leadership. Proponents of this analysis suggest that increasing pilot quality of life and quality of service is the most effective way to combat the deep pockets of the commercial aviation industry. They acknowledge that the Air Force will never be able to out-pay the airlines, therefore revitalizing the unique benefits of military service will increase retention more than additional compensation.

This relatively new vein of analysis has to-date neglected the role basing plays on retention. Many quality of life determining factors are a function of the installation and community where pilots and their families work and live. Placing pilots at installations and in communities where they are most likely to experience high qualities of life and service is a currently unstudied retention improving solution. The following chapter will outline the Air Forces basing posture and policies governing its basing decisions.

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9 See Stahl, Mintz, and Carson.
3. Basing Policy and Pilot Retention

The previous chapter noted that the USAF’s basing posture is an understudied contributor to pilot retention. This chapter will familiarize readers with the current Air Force basing posture, introduce governing Air Force basing policy, and review relevant basing analysis.

Current Posture

The Air Force currently conducts active duty fighter training and operations at twenty-seven non-deployed locations. These installations span five major commands, three continents, and complete missions ranging from initial pilot training to providing regional security. The Air Force’s active duty domestic fighter assets are primarily organized under Air Combat Command (ACC). ACC is the primary force provider of combat airpower to the United States’ warfighting commands. ACC “trains, equips and maintains combat-ready forces for rapid deployment and employment while ensuring strategic air defense forces are ready to meet the challenges of peacetime air sovereignty and wartime air defense.” ACC installations are located across the continental United States, and is headquartered at JB Langley-Eustis, VA (Air Combat Command, 2020).

The majority of remaining active duty domestic fighter assets are organized under Air Education and Training Command. AETC’s mission is to “recruit, train and educate Airmen to deliver 21st Century Airpower.” Regarding flying operations, AETC conducts all training during the production phase of the aircrew management pipeline. In the fighter pipeline this consists of Initial Flight Training, Undergraduate Pilot Training, Introduction to Fighter Fundamentals, Survive, Evade, Resist and Escape Training, and concludes with Formal Training Unit training regimens. AETC is headquartered at JB San Antonio-Randolph and operates mainstay Air Force installations such as Luke AFB, Columbus AFB, and Laughlin AFB (AETC, 2019).

Figure 3.1 maps the twenty-one Continental United States (CONUS) installations included in this study. The vast majority of these bases host flying squadrons responsible for training, testing or operating fighter pilots and/or aircraft. Neither the Pentagon nor Maxwell Air Force Base (AFB) host flying squadrons but are included in this study due to the large numbers of fighter pilots stationed there.

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10 ACC shares the training mission with AETC, who completes all initial pilot training.

11 Remaining active duty domestic fighter assets execute the test and evaluation mission, and fall under Air Force Materiel Command (AFMC). Edwards AFB is the only AFMC installation included in this study.

12 Pilots selected to become F-22 pilots also complete an additional F-22 lead-in course after completing IFF but before attending their FTU.
The Pacific Air Forces (PACAF) are another major tenant of Air Force active duty fighter operations. This major command “delivers agile air, space and cyberspace capabilities in support of U.S. Indo-Pacific Command’s (USINDOPACOM’s) objectives, uniting allies and partners to enhance regional stability and security.” They are headquartered at Joint Base Pearl Harbor-Hickam, and operate installations across the Indo-Pacific region including Alaska, Japan and South Korea. Pacific Command (PACOM) operates active duty fighter squadrons at Eielson AFB and Joint Base Elmendorf-Richardson in Alaska, Osan and Kunsan Air Bases (ABs) in South Korea, and Misawa and Kadena ABs in Japan (USAF, 2020). Each of these installations are included in this study and mapped in Figure 3.2.
The last Major Command controlling part of the Air Force active duty fighter enterprise is United States Air Forces Europe and Air Forces Africa (USAFE-AFAFRICA). This major command “Forward project[s] power across air, space and cyber domains, defend[s] United States (U.S.) interests, demonstrate[s] warfighting readiness, and forge[s] strong partnerships in support of United States European Command (USEUCOM) and United States Africa Command (USAFRICOM) campaign objectives.” USAFE-AFAFRICA operates fighter aircraft at Aviano AB in Italy, Spangdahlem AB in Germany, and Royal Air Forces (RAF) Lakenheath in the United Kingdom (USAFE-AFAFRICA, 2020). These installations are mapped in Figure 3.3 and each is included in this study.
Governing Policies

This section introduces the two dominant policies driving Air Force basing decisions: the Air Force Strategic Basing Process and the Base Realignment and Closure process.

Air Force Strategic Basing Process

The AFSBP is detailed in Air Force Instruction (AFI) 10-503 and applies to Active Duty Air Force, Air Force Reserve command, Air National Guard and other Services/Agencies requesting basing actions of one year or longer. It “provides an enterprise-wide transparent, defendable, and repeatable process for decision making to ensure all strategic basing actions involving Air Force (AF) units and missions support AF mission requirements” and comply with environmental guidance (AFI 10-503, 2017).

Actions that fall under the jurisdiction of the AFSBP include:

- Weapon system changes. Including additions, subtractions or MDS replacement, but excluding tail swaps.
- Any action that changes the permanent party and/or contractor personnel at an installation by at least 35.
- A unit movement, as defined in AFI 16-403.
- A non-Air Force entity requesting to move onto an Air Force installation or Air Force real property.
- Any action by a non-Air Force entity on an Air Force installation or Air Force real property that results in a change to their primary mission. Including an increase in airspace or range requirement/usage and/or a change in personnel of at least 35.
• An Air Force or non-Air Force entity continuous rotational presence or temporary duty on an Air Force installation or Air Force real property that will require the need for new construction or is greater than 300 days in a consecutive 18 month with an increase of 35 or more personnel, not including base operating support.

• Any special interest action, as defined by SAF/IEIB

• Notable exclusions include BRAC actions as well as expeditionary and contingency operations (AFI 10-503, 2017).

If a basing action falls under the provision of the AFSBP, its execution is managed by the Air Force Strategic Basing Structure (AFSBS). This organization ensures that the AFSBP is conducted in an enterprise-wide, fact-centered manner, and ultimately presents their recommended course of action to the Secretary of the Air Force. The AFSBS is composed of the Strategic Basing Executive Steering Group (SBESG) and the Strategic Basing Panel (SBP). The SBESCG is composed of one- and two-star general officers and civilian equivalents dedicated to cross-functional consideration of strategic basing actions. The SBP consists of Colonels and civilian equivalents who support the SBESG. Together the two groups provide multifunctional, cross-staff perspective on basing decisions to enhance issue responsiveness and support interactive corporate decision-making (AFI 10-503, 2017).

The strategic basing process is initiated when a proponent submits a basing action request (BAR) to the Office of the Assistant Secretary of the Air Force for Installations, Environment, and Energy, Strategic Basing (SAF/IEIB). SAF/IEIB then designates a lead major command (MAJCOM) to coordinate the BAR with appropriate agencies before it meets the SBP. If warranted, SAF/IEIB may conduct an initial investigation to solicit AFSBS guidance on the action prior to formal staffing through the AFSBP. Next the lead MAJCOM will develop basing criteria and generate an enterprise wide list of installations for consideration. The lead MAJCOM will also designate weights for each criterion. Upon receiving feedback and approval from SAF/IEIB, the leading MAJCOM will publicly release the list of criteria, and installations under consideration. These criteria include but are not limited to an installation’s: ability to support the mission, capacity, environmental impact, and economic factors. They will then begin the data collection process (AFI 10-503, 2017).

In coordination with all affected MAJCOMs, the lead MAJCOM will gather data from each installation under consideration regarding each criterion. The collected data reflects the current state of the installation and is then scored in accordance with the previously approved weighting scheme. The scored enterprise-wide list is then presented to the Secretary of the Air Force (SecAF) with SBESG’s perspective, and the SecAF selects a subset of the list for site survey. Selected bases are then visited and more thoroughly evaluated in line with the predetermined criteria. A noteworthy component of the site visits are the initiation of environmental impact analysis and completion of basing life cycle cost analysis. Following the completion of site surveys, the SBP, SBESG and the AF Board for SecAF approval review, validate and endorse a preferred alternative. Once the selection of a preferred alternative is completed, the results are
made public, and environmental impact analysis is completed. The basing decision is executed after Congress is notified of the decision (AFI 10-503, 2017).

**Base Realignment and Closure Process**

The Defense Base Closure and Realignment Act of 1990 created a Commission and process to facilitate the timely closure and realignment of military installations inside the United States. The Commission was to be an independent body consisting of eight members appointed by the President, by and with the consent of the Senate. Many of the Commission members would be retired military officers, out of office politicians, and business leaders. The process outlined in the law called for the BRAC Commission to analyze and amend an installation closure/realignment list first generated by the DoD, and ultimately approved by the President and Congress in an all-or-nothing fashion (101st Congress, 1990).

The BRAC process begins with the Secretary of Defense’s proposed force-structure plan. In generating this plan which accompanies the DoD’s budget request to Congress, the Secretary of Defense considers probable threats and available resources and generates a proposed force-structure capable of addressing these threats. This plan is agnostic to specific military installations. It also includes a description of the anticipated implementation of the Secretary’s plan (101st Congress, 1990).

Next the Secretary proposes a list of criteria that will be used to determine which installations should be closed or realigned. These criteria must be made public for thirty days, allowing time for public comment. The criteria are then finalized and used in accordance with the force structure described above to make recommendations for the closure/realignment of military installations. In considering closures/realignments, the Secretary considers all installations within the United States equally, without consideration for past debate for closure. Any advance conversion planning taken by communities regarding an anticipated installation closure should also not be considered. The Secretary must deliver to Congress every piece of information the Commission used in making their recommendations (101st Congress, 1990).

Upon receiving recommendations from the Secretary of Defense, the BRAC Commission conducts public hearings reviewing the recommendations. Their review includes analysis of DoD recommendations where the Commission is able to make changes if they find that the Secretary meaningfully deviated from their previously submitted force structure or final decision criteria. Upon the completion of their analysis, the Commission submits their recommendations to the President of the United States (101st Congress, 1990).

If the President agrees with the Commission’s recommended actions, the Commission sends the approved list of closures/realignments directly to Congress. If the President disagrees, the President can submit feedback to the Commission, who then incorporates that feedback, and resubmits their report to the President. If the President approves, they can submit their new list of approved actions to Congress, or if they disagree, terminate the entire process. At this point Congress must approve or disagree with the recommendations in totality. Congress cannot
approve of some actions while disapproving of others. This measure attempts to limit pork barrel politics. If the recommendations are approved, the Secretary of Defense can proceed with closing/realigning installations, supporting the local communities through the transition, completing environmental restorations, and divesting from installation assets (101st Congress, 1990).

Analysis of Basing Policies

This section discusses relevant scholarship to the Air Force’s basing policies and posture.

Air Force Strategic Basing Process

In 2016 the Air Force commissioned a RAND team led by Constantine Samaras to evaluate the Air Force Strategic Basing Process by studying the criteria, data, and strategic vision employed during basing decisions. Samaras and his team answered three main questions:

1. Are basing decision criteria aligned with Air Force intentions?
2. Are the data used in the Air Force’s strategic basing decisionmaking process authoritative, consistent, and auditable?
3. Is there potential for broader Air Force strategic or portfolio-wide inputs to strengthen the basing decisionmaking process?

To answer the first question, Samaras and his team compared the Air Force’s assigned criteria weights to the basing decision outcomes for 25 basing actions. The team leveraged RAND’s Generalized Boosted Model (GSB) to calculate the “relative influence” of each criteria on actual retention decision outcomes, and then compared these estimates to the criteria weight assigned by the Air Force in that basing decision. The degree to which basing decision’s GSB estimated “relative influence” differs from the Air Force designated criteria weights indicates the degree of alignment between the Air Force’s stated intentions and actual outcomes. Their results analytically validate that the Air Force’s intentions are in line with basing decision outcomes (Samaras et al., 2016).

To investigate the quality of data used in the AFSBP Samaras’ team studied data gathered from candidate installations in enterprise-wide KC-46 and F-35 basing decisions. They measured authoritativenss by comparing data received through AFSBP data calls to that found in credible sources. They measured consistency by recording the extent to which bases use the same sources to answer the same questions. Lastly they calculated an auditability score by measuring data sources’ traceability and documentation. The study found that the data used in the AFSBP is authoritative and consistent, but not always auditable. They discovered that mission related criteria drive finalist selection, but capacity related criteria drive the ultimate decision.

In response to their third research question, Samaras and his team found that the AFSBP does not sufficiently account for the Air Force strategic objectives. The Air Force makes foreign basing decisions by fully considering installations’ strategic and diplomatic value. The Service
makes domestic basing decisions by focusing on an installation’s ability to support the local mission. This emphasis neglects enterprise-wide strategic considerations for local units’ singular needs. Moreover, Samaras concludes that this shortcoming is a post-Cold War phenomenon (Samaras et al., 2016).

**BRAC Discussion**

The BRAC process was completed five times from 1988 to 2005, but has not been employed in the last fifteen years. An intricate web of stakeholders and interests complicate the process, making it unclear if or when the next BRAC will take place. Proponents of a new BRAC assert that the armed services are wasting money maintaining infrastructure they no longer need to support the current force structure. Equally loudly, opponents advocate that a new BRAC would be too expensive, absorbing too much political and fiscal capital for too little in savings.

In a 2015 opinion piece “Time for a new BRAC,” Anthony Principi, the Chairman of the 2005 BRAC Commission, argues that it is the nation’s duty to allow the DoD to unburden itself from excess infrastructure. In a fiscally constrained budget environment, Principi suggests that the DoD will cut infrastructure spending with or without a BRAC. He believes that a formal BRAC process offers affected communities transparency and support in a tumultuous time. He labels the alternative a “stealth BRAC,” where budgetary pressures still motivate the DoD to cut expenditures on excess infrastructure, but affected communities are not given the support they would receive under a formal BRAC (Principi, 2015).

Despite his insistence that initiating BRAC is the appropriate thing to do, BRAC supporters like Principi acknowledge the challenges lawmakers face. Activating a BRAC could force congressmen to vote on closures/realignments that their constituents disagree with. Moreover, BRACs may eliminate/reduce the military presence at an installation within congressmen’s jurisdiction. These are intimidating and troubling realities for congressmen, but Principi argues that BRAC mandated base closures/realignments are not as detrimental to communities as commonly feared, and that the alternative is worse (Principi, 2015).

Opponents to a new BRAC often believe base closures are too costly on military communities, are politically unpalatable, and that the expected savings are overstated. Critics tout BRAC’s high up-front costs and suggest that savings are realized too far into the future. A 2012 Government Accountability Office report supports these fears with an account of dramatically increased costs and decreased expected savings from BRAC 2005 recommendations. The DoD projected that implementing recommendations from the 2005 BRAC would cost about $21 billion. For comparison, the previous four rounds of BRAC cost $25 billion combined. The BRAC Commission asserted that in 20 years, BRAC 2005 measures would achieve a positive net present value of $35.6 billion, with annual savings about $4.2 billion. In reality, implementing the 2005 measures actually cost $35.1 billion, 67% more than

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13 Net present value is the present value of future savings minus the present value of up-front investment costs.
the DoD estimated. Additional construction costs caused most of the cost overruns. To make matters worse, the net present value of the closures/realignments had also slipped to $9.9 billion, a decrease of 72% (GAO, 2012).

The legacy of the 2005 BRAC continues to cast a shadow over the possibility of a future BRAC. Although a BRAC request had been included in each of the previous six budget requests, the Trump Administration did not include a BRAC request in their 2019 or 2020 defense budget requests (Shane, 2019). The DoD continues to highlight the spending required to maintain unnecessary infrastructure, but for the time being, neither the President nor Congress appear motivated to launch another round of BRAC (Hlad, 2016).

Additional noteworthy basing analysis

The Air Force’s basing posture has immediate consequences for its combat capability, personnel system, and budget. As such the basing posture has been an object of meaningful analysis for years. Much of this research has centered around how the Air Force can base “optimally.” And in most cases optimally means most inexpensively. An assessment of how the Air Force’s basing posture can shape the future force should be rooted previous discoveries.

The evolving role of U.S. military installations

In her 2012 piece “U.S. Global Defense Posture, 1783-2011” Stacie Pettyjohn traces the evolution of the U.S. strategic basing posture from the country’s origin in 1783 through today’s alignment. She asserts that the U.S.’ basing posture is a critical determinant in its ability to project power throughout the world, cement relationships with allies, and deter threats. Understanding the key stakeholders and drivers of the U.S. national defense posture helps decision makers understand the gravity of current decisions and learn from the previous basing decisions.

Pettyjohn examines U.S. basing postures in numerous eras with a framework that focuses on the extent of U.S. forces abroad, and their operational orientation. She leverages this framework to explain the U.S.’ evolution from a regional power concerned with continental defense into a global hegemon with a military presence around the globe. Through her analysis Pettyjohn highlights four benefits of CONUS basing. First, domestically stationed forces are well positioned to fulfill the homeland defense mission. Second, they enjoy significantly more freedom to train and maneuver. Third, domestically stationed forces are able to live with their families, leading to a higher quality of life than those in unaccompanied assignments. Lastly, CONUS bases are more survivable. Pettyjohn also notes that OCONUS basing is not without its advantages, which include enabling timely responses to global contingencies, simplifying the logistic demands of an OCONUS campaign, and strengthening relationships with allies.

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14 Operational orientation describes if the forces are stationed in garrison, which means they expect to fight where they are based, or expeditionary, which means they intend to project power into another theatre.
Decreasing Costs by Manipulating Squadron Size, Component Affiliation, and Location

In their 2013 work “Assessment of Beddown Alternatives for the F-35” Ron McGarvey and his team identify cost savings that could result from changes to the squadron size, distribution of primary aircraft authorized (PAA) across the active and reserve components, and the percentage of PAA assigned to CONUS F-35A installations. The team prosecutes their analysis by evaluating twenty-eight possible beddown alternatives on their ability to meet five criteria. The criteria include “support surge and steady-state contingency operations,” “support pilot absorption,” and “develop future senior leaders out of the pool of fighter pilots.”

The team generates twenty-eight beddown alternatives by varying the PAA distribution between active and reserve component squadrons, the size of squadrons (measured in PAA), and the percentage of PAA stationed CONUS vs OCONUS. They measure each basing alternative’s quality by comparing each to existing squadron performance criteria. For example, to determine each alternative’s ability to meet surge and steady-state deployment requirements, McGarvey’s team derived potential force requirements from prior USAF A9 analysis. They compared each beddown alternative’s ability to deploy forces to A9 requirements and determined if each could do so while maintaining desired deploy-to-dwell ratios. To examine each alternatives ability to support pilot absorption, McGarvey and his team leveraged a steady-state aircrew management model. They deemed an alternative “feasible” if it can maintain experience thresholds, maintain pilot quantities, and allow pilots to meet ready aircrew program (RAP) minimums under realistic UTE rates.

They conclude that substantial cost savings could be achieved by increasing squadron size and consolidating PAA at fewer installations. Savings stem from decreases in absorption flying costs and the creation of economies of scale that more efficiently employ maintenance infrastructure and support personnel. These conclusions support the BRAC debate by advocating for cost savings that result from installation consolidation.

Supporting Training Quality while Minimizing Costs

In their 2016 report “A Modeling Framework for Optimizing F-35A Strategic Basing Decisions to Meet Training Requirements,” Anu Narayanan and her team assert that enterprise wide strategic considerations should be included in the Air Force’s strategic basing process. Air Force training is inherently risky and costly, but the extent of risk and cost born by the service to execute training depends on its basing posture. Both can be reduced by basing fifth generation fighter squadrons near advanced ranges. Looming range upgrade and F-35 basing decisions make this reality more particularly relevant, and uniquely positions the Air Force to make lasting change.

Narayanan supports her assertions with an optimization model that determines preferred basing posture for F-35 squadrons, locations for composite force-training (CFT) exercises, and the number of aircraft sent from each base to each CFT exercise. The model optimizes by
minimizing the total F-35 flying costs to and from required regional training events. Ranges selected to host training events are also best positioned to receive upgrades.

The release of primitive F-35 training requirements indicate that current primary training ranges (PTRs) are incapable of hosting major portions of required F-35 training. Most PTRs lack the airspace and threat replication capabilities required to host large CFT events. Stationing F-35 units close to ranges that can host CFTs produces significant cost savings.

Narayanan’s team’s work demonstrates the importance of considering enterprise-wide basing decisions in context with other competing interests; like training quality and costs. Narayanan accurately suggests that the Air Force’s basing posture can support the service’s operational needs in a way that generates increases in training quality and financial savings.

**Supporting Military Families**

In recent years, viewing quality of life as an important determinant of servicemember retention has gained support among policymakers. In a 2018 letter to the National Governors Association, the Secretaries of the Army, Navy and Air Force encouraged governors to support military personnel in their states by providing their children access to high quality schools, and their spouses opportunities for employment. The Secretaries acknowledge that military families often cite difficulties assimilating into new school districts, low quality schools, and the inability for spouses to maintain meaningful employment as common hardships associated with military service. They challenge governors to prioritize legislation that eases professional licensure transfers for military dependents, and to identify and proliferate practices that support military families’ assimilation into local school districts (Spencer, Wilson and Esper, 2018).

In February 2020, the Air Force announced its plans to incorporate quality of life considerations into the AFSBP. Secretary of the Air Force Barbara Barrett supported the new policy saying “the communities where service members live and work impact readiness, retention and the satisfaction of families. Future basing decisions made with a consistent framework will ensure optimal conditions for service members and their families.” In line with the Secretaries’ 2018 recommendations to governors, the new Air Force policy will quantify the quality of local public schools, and the ability of states to receive professional licensures, and incorporate those criteria into the Strategic Basing Process (SAF, 2020).

Pilots may be especially perceptive to low qualities of life due to the transferability and value of pilots’ skills in the civilian workforce. Their training all but guarantees that they could find a high paying position in the civilian workforce should they decide to separate from the Air Force. If pilots and their families are unhappy, they are very equipped to transition into a career with the civilian airlines offering lucrative pay, and the ability to homestead in a major metropolitan area (Rosello et al., 2016).

Basing posture influences pilot retention, but the Air Force has traditionally had little flexibility in manipulating its posture to meet present needs. However, as the Air Force adds more F-35s to its fighter fleet it will create new squadrons to host the new aircraft. Changing
MDS at an installation necessitates the completion of the Strategic Basing Process, which will give the Air Force the opportunity to alter its domestic basing posture without a Congressionally mandated BRAC.

Summary

The Air Force’s basing posture is intimately related to the Service’s ability to complete its mission as outlined in the 2018 National Defense Strategy (NDS). The optimal basing literature is rich with analysis suggesting improvements to the Air Force’s current basing posture that will increase training quality, minimize training cost, and minimize training’s exposure to natural disasters. Moreover, it is generally agreed upon that the AFSBP does not incorporate enterprise-wide strategic considerations into basing decisions. One of these strategic concerns that has received relatively little attention from basing analysts is pilot retention. To date, little to no analysis has been conducted to better understand if the Air Force’s basing posture affects pilot retention. The remainder of this dissertation will analyze how the installations where pilots are stationed affect their retention decisions. The following chapter begins this analysis by introducing the methodology and model used to estimate installations’ contributions to pilot retention outcomes.
4. Modeling Pilot Retention Decisions

This chapter introduces a new method for identifying potential improvements to the Air Force’s pilot retention policy. This chapter introduces value-added model capable of estimating installations effects of pilot retention outcomes. The chapter first introduces the value-added modeling technique in its native education context, then explains how and why these models can be adapted to aircrew management applications. Next the components of fighter pilot retention decisions are explored in order to develop a theoretical understanding of pilots’ decision-making process. Lastly the value-added model and data used throughout the remainder of this dissertation are introduced and discussed.

Value-Added Modeling

Although this dissertation focuses on aircrew management, the type of model used to complete the analysis is most commonly used in education research. For this reason, it will initially be introduced in an education context, and later its adaptation to aircrew management will be explained. Value-added models (VAMs) are used throughout the education literature to measure teacher quality. Teacher quality has traditionally been challenging to measure due to the difficulty of resolving endogeneity concerns limiting analysts ability to make “apples-to-apples” comparisons. However, VAMs leverage fixed-effect terms and lagged variables to account for confounders and unobservables in a way that generates unbiased estimates of teacher quality that can be compared across classrooms, schools, and districts (Chetty, Friedman and Rockoff, 2014).

VAM estimates of teacher quality are predicated on an additive understanding of students’ cognitive achievement. This developmental paradigm suggests students’ intellectual capability is a function of their natural ability and the cumulative effect of all inputs experienced over their lifetimes. These inputs originate from a host of different sources including parents, teachers, students, other children and a limitless list of other sources. The sheer number of inputs students receive coupled with their range of sources makes a complete accounting impossible. This reality produces the endogeneity concerns mentioned earlier (Todd and Wolpin, 2003).

Value-added models employ fixed-effects terms to estimate the effect of one input, having a certain teacher, while accounting for natural ability and all other cognitive inputs students have received. Analysts include as much information about the students as possible to isolate teacher’s effects on their pupils. The covariates included typically describe the demographics of students and their parents, the socioeconomic status of students’ parents, students past standardized test scores, classroom descriptors, and school descriptors. When formulated correctly, teachers’ effects can be isolated from confounding variations in student aptitude and other shocks (Opper, 2019).
Chetty, Friedman and Rockoff’s 2014 publication “Measuring the Impact of Teachers I: Evaluating Bias in Teacher Value-Added Estimates” is a canonical application of value-added modeling. The authors employ a VAM that estimates teacher causal impacts on student achievement. Their model derives implicit teacher value by comparing student performance to a student-specific baseline, accounting for observables, and attributing any remaining deviation in student performance from expected performance to that student’s teacher (Chetty, Friedman and Rockoff, 2014).

VAMs are not without limitations. VAM estimates produce measures of relative effectiveness and are traditionally less capable of producing comprehensive indicators of effectiveness. VAM estimates are well suited to compare singular outcomes (ex. test scores, patient outcomes) across entities (ex. teachers, hospitals). Their estimates are relative to the other entities included in the data. For example, the value VAMs assign to teachers is only relative to the other teachers included in the analysis. Moreover, good teachers do far more than increase their students test scores. VAM results that assign teacher value based on increased test scores should be taken in context with other measures of teacher proficiency such as classroom management, lesson design, and student emotional development.

**Applying VAMs to Aircrew Management**

Identifying how installations affect retention is similar to measuring teachers’ effects on student test scores. Both are complicated processes heavily dependent on prior inputs and unobserved traits. VAMs are well suited to these types of problems. Moreover, the limitations of value-added models do not limit their ability to assess installations’ effect on pilot retention. The objective of such analysis is to compare a single outcome (pilot retention) across multiple entities (military installations). The value of these estimates is relevant within the context of military installations other responsibilities, and relative to other military installations in the USAF inventory. For these reasons VAMs are an appropriate tool to generate estimates of installation-effects.

Education focused VAMs account for a wide range of characteristics about students in order to compare similar students and establish unbiased estimates of teacher quality. This dissertation seeks to do the same thing by comparing the retention outcomes of similar pilots stationed at different installations. Doing so will generate unbiased estimates of installations’ effects on pilot retention. In the education space, doing so requires a robust theoretical model of cognitive development. In the aircrew management space, doing so requires a complete model of pilot retention decisions. The following section will dive deeply into pilots’ retention decision making process.
Understanding Pilot Retention Decisions

Before pilots’ retention decisions can be modeled, they must be understood. Pilots’ decisions are influenced by their past experiences, present realities and expected future opportunities. This section will discuss the factors influencing USAF pilot retention decisions, introducing and discussing each in independent subsections.15

Pay

The pay Air Force pilots receive is multifaceted. Pilots receive their base pay, basic allowance for housing (BAH), basic allowance for subsistence (BAS), Aviator Incentive Pay, and are sometimes eligible to receive an Aviation Bonus. Military base pay is determined by the servicemembers rank and time of service. As pilots increase in rank and time served, their base pay increases. The amount paid at each pay grade also tends to increase over time via military pay raises that are typically included in each defense budget.

The value of pilots’ BAH is dependent on three things: duty station, rank, and whether the servicemember has dependents. This pay is meant to offset the cost of housing when the servicemember is not housed on a military installation. It increases with the local cost of living, rank, and if the servicemember takes on dependents. BAS is a pay intended to offset the cost of purchasing food, and is constant in value across all duty stations, ranks, and the presence/absence of dependents.

Aviator Incentive Pay is one of the two special pays offered to pilots. Active duty pilots, including those in training, receive AvIP as long as they meet specified eligibility criteria. To be eligible, pilots must fly at least eight of their first twelve years of aviation service (YASs). This practice is colloquially known as meeting your “gates” (Sweeney, 2015). In practice AvIP is a monthly pay to qualified pilots that increases with YAS. As shown in Table 4.1, payments begin during UPT at $150 per month and increase to $1,000 per month for pilots with between 13 and 22 YASs. Payments decrease after pilots complete 22 YAS (Mattock and Asch, 2019).

Table 4.1 AvIP Payments by YAS

<table>
<thead>
<tr>
<th>Years Aviation Service (YAS)</th>
<th>2 or Less</th>
<th>Over 2</th>
<th>Over 6</th>
<th>Over 12</th>
<th>Over 22</th>
<th>Over 24</th>
</tr>
</thead>
<tbody>
<tr>
<td>AvIP Payment ($)</td>
<td>150</td>
<td>250</td>
<td>700</td>
<td>1,000</td>
<td>700</td>
<td>450</td>
</tr>
</tbody>
</table>

Source: Department of Defense, 2020

Compensating aviators beyond the rate of non-flying servicemembers has been standard military practice since the advent of military aviation. However, it has only recently become an Air Force policy lever to shape force management (Metrolis, 2003). The value of AvIP changes

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15 Sweeney, 2015 provides a robust discussion of retention influencers. This section draws heavily from his work.
in line with the retention needs of the Air Force. Recently the pilot shortage has been most acute with mid-career and senior aviators, those with between twelve and twenty-two YASs. These YAS brackets are the most highly compensated via AvIP, demonstrating that the Air Force is using AvIP to combat specific retention needs (Sweeney, 2015).

The Aviation Bonus is the second of the Air Force’s special pay for pilots. It currently consists of annual payments of up to $35,000 paid to pilots serving under contracts of between three and twelve years following the completion of their initial ADSC. Pilots who commit to long-term contracts are eligible for lump-sum up-front payments of up to $100,000 for seven to nine year contracts and $200,000 for ten to twelve year contracts (SAF PA, 2019).

A program offering pilots retention bonuses was first written into law in 1981 and offered pilots an additional $6,000 per year of service for YAS 6-12. Since 1981, Congress has increased the value of AvB multiple times. When pilot communities are healthily staffed AvB rates tend to remain constant, and are increased in response to current or projected shortages (Dalonzo, 1999).

The value of military pay affects retention decisions through two primary channels. First, it affects pilots’ financial realities at the time of their retention decisions. If pilots are struggling to make ends meet, or unable to save for their future, they may be more inclined to separate. Secondly, pilots’ pay affects the appeal of opportunity costs. Pilots considering a civilian career will likely compare their expected earnings in the military with their expected earnings in the civilian sector. Specifically, many pilots compare their expected military wages to their expected wages flying for the commercial airlines. Figure 4.1 compares USAF pilot compensation to major airline’s salaries from 2000 to 2015. Figure 4.1 represents USAF wages by plotting the salaries of USAF pilots who are Majors, with twelve years of service, and have accepted an aviation bonus. Both Air Force and major airline pay has been increasing since 2000, after adjusting for inflation. Moreover, the real gap in pay between the airlines and the Air Force has remained relatively constant over the last fifteen years.
In comparing military pay to expected major airline pay, pilots must also consider the temporal aspect of their separation. The pilots flying for the civilian airlines are highly unionized in a way that emphasizes seniority and staying with the same airline for one’s entire career (Rosello et al., 2016). The point at which a USAF pilot decides to transition from military service into the commercial space has serious implications on their expected lifetime earnings. In their 2016 report titled, “Can the Air Force and the Airlines Collaborate for Mutual Benefit?”, Anthony Rosello and his team estimate the career earnings of pilots separating from the USAF at different times, some affiliating with the reserve component and others not, and then flying a second career with a major commercial airline. Rosello and his team found that pilots who join a commercial airline after twenty-five years of service in the USAF could expect to earn over $2.5M less in career earnings than pilots who separate upon completing their initial ADSC.

Table 4.2 compares Rosello’s estimates of the career earnings of five archetypical pilots who end their careers flying for a major airline. The first is a pilot who retires from military service as an O-6 after twenty-five years of service, and then flies for a civilian airline until they reach the FAA required retirement age of 65. The second is a pilot who retires from military service as an O-5 after twenty-five years of service, and then flies for a civilian airline until retirement. The third is a pilot who separates from the USAF after the completion of their initial ADSC, does not affiliate in the reserve component, and then flies for the civilian airlines until retirement. The fourth is a pilot who separates from the USAF after the completion of their initial ADSC, flies in the reserve component until reaching retirement eligibility, and flies for the civilian airlines until retirement. The fifth is a non-military aviator who receives their flying training from a civilian
flight school, first flies for a regional airline, and then flies for a major airline until retirement. Rosello and his team estimate and compare the career earnings of each pilot at 65.

<table>
<thead>
<tr>
<th>Table 4.2 Career Earnings for Pilots Separating at Different YOS</th>
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<tbody>
<tr>
<td>Retire Military After 25 Years of Service as O-6, Career Airline</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Total Earnings at age 65 ($M)</td>
</tr>
<tr>
<td>Difference from baseline ($M)</td>
</tr>
<tr>
<td>Source: Rosello, 2016</td>
</tr>
</tbody>
</table>

In his 2015 dissertation titled “Air Transport Pilot Supply and Demand,” Michael McGee confirms the relevance of airline salaries and hiring schedules on military pilot retention. He asserts that 88% of the variation in USAF pilot separations can be explained by the variation in major airline hiring. In light of such an appealing alternative, the USAF uses ADSCs and retirement incentives to control the flow of pilots out of the military.

**Additional Duty Service Commitments**

When servicemembers complete certain training regimens or receive financial assistance from the Air Force, they sometimes incur an additional duty service commitment. The Air Force asserts that these ADSCs ensure that the taxpayers receive an appropriate return on investment for money invested in servicemembers via training, education and/or bonuses (USAF, 2018). For example, if an Air Force officer earns their commission via graduation from the Air Force Academy, they incur a five-year ADSC, meaning they must serve on active duty for five years before they are eligible to request separation. This section will discuss the most relevant ADSCs fighter pilots incur, and how they affect pilots’ retention decisions.

**Initial ADSC**

After successfully completing undergraduate pilot training, pilots incur a ten-year ADSC. The length of this initial ADSC is important because it determines when pilots are first eligible to request separation from active duty. The length of this commitment has varied over time and is a policy lever that the Air Force has historically employed to increase their supply of pilots. Prior to 1987, the length of pilots’ initial ADSC was six years (Guzowski, 1990). Due to pilot shortages, specifically in midcareer pilots with six to twelve years of service, the length of the
initial commitment was extended to seven years in 1987, and eight years in 1988. Initial ADSC length remained constant through the 1990s, but was increased once more to ten years in 1999 (Metrolis, 2003).

Other ADSCs

Pilots may sign other ADSCs throughout their careers in addition to their initial ADSC. These service commitments are commonly incurred by pilots who receive advanced training, advanced education, an Aviation Bonus, PCS, or transfer their Post 9-11 GI Bill benefits to their spouse/children.\(^{16}\) Table 4.3 outlines the length of common ADSCs incurred by pilots.

<table>
<thead>
<tr>
<th>ADSC Reason</th>
<th>ADSC Length (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPT</td>
<td>10</td>
</tr>
<tr>
<td>Test Pilot School</td>
<td>3</td>
</tr>
<tr>
<td>USAF Weapons Instructor Course</td>
<td>3</td>
</tr>
<tr>
<td>Federally Sponsored Fellowships &amp; Education Programs</td>
<td>3x the length of the program</td>
</tr>
<tr>
<td>Tuition Assistance</td>
<td>2</td>
</tr>
<tr>
<td>Aviation Bonus</td>
<td>3-11</td>
</tr>
<tr>
<td>PCS</td>
<td>1-2</td>
</tr>
<tr>
<td>Post 9-11 GI Bill Transfer of Education</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: AFI 36-2107, 2018

The accrual and completion of ADSCs determine when pilots make retention decisions. Pilots cannot separate from the Air Force if they have outstanding ADSCs, therefore their opportunities to do so are determined by the ADSCs pilots incur.

Retirement Pay and Benefits

The Air Force also incentivizes pilots to continue their active duty service beyond the length of their initial ADSCs with desirable retirement benefits. Servicemembers who serve at least twenty years on active duty are eligible for retirement pay, healthcare, and other benefits.\(^{17}\) Pilots who made retention decisions between 2000 and 2019 are eligible for one of three retirement

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\(^{16}\) As of August 1, 2009, servicemembers are eligible to transfer their unused Post-9/11 GI Bill benefits to a beneficiary enrolled in the Defense Enrollment Eligibility Reporting System (DEERS) if they have completed at least six years of service, and sign an ADSC committing to four more years of service (U.S. Department of Veterans Affairs, 2020).

\(^{17}\) Other benefits include memorial benefits, military legal assistance, and the ability to continue using on-base facilities like the Base Exchange, commissary, and gym.
systems: Final Pay, High-36, or REDUX. Each offers a defined benefit that increases in size with years of service and rank. REDUX also offers a lump-sum payment at 15 years of service (YOS) that accompanies an obligation to serve through twenty YOS (DoD, 2020).

The “cliff-vested” nature of each retirement system creates an “all or nothing” incentive for pilots to reach twenty years of active duty service. Given the value of a military defined benefit, a pilot’s perceived likelihood of reaching twenty YOS and their proximity to that point influence the retention decisions of even mid-career Captains. The advent of the Blended Retirement System (BRS) will mitigate some of the effects of the cliff-vesting. Nonetheless, as long as retired military benefits center around a defined benefit that servicemembers become eligible for after twenty years of service the incentive to reach twenty years of active duty service will remain a valuable retention tool.

The military pay, ADSC, bonus, and retirement structure combine to create a complex retention landscape for pilots. All pilots must serve until at least 11 YOS to fulfill their initial ADSC. This is a major decision point for aviators. As Rosello and his team demonstrated in 2016, pilots who separate at this point and immediately join a civilian airline have higher earnings potential than pilots that remain on active duty. However, the Air Force has tried to close this gap in expected earnings by offering large AvBs to pilots willing to sign lengthy ADSCs. For pilots who continue serving on active duty beyond their initial ADSC, each additional year of service brings pilots closer to retirement eligibility and makes pre-retirement separation less desirable. These complicated realities force pilots to consider their retirement prospects from their earliest retention decision (Sweeney, 2015).

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18 The Final Pay retirement program is a defined benefit paying retirees 2.5% times the number of years of service times the retiree’s final base pay on their day of retirement per month. The High-36 retirement plan pays retirees 2.5% times the number of years of service times the average of the retiree’s highest 36 months of base pay per month. The REDUX retirement program pays a $30,000 bonus once the servicemember reaches 15 YOS, which includes an obligation to serve through 20 YOS. The retiree is then eligible for a defined benefit equal to 2.5% times the years of service minus 1.0% for every year of service less than 30, times the average of the retiree’s highest 36 months of base pay. Once the retiree reaches 62 years of age, the defined benefit pays 2.5% times the number of years of service times the average of the retiree’s highest 36 months of base pay per month (DoD, 2020).

19 Cliff-vested refers to the idea that a pilot with 19 years of service is not eligible for any retirement benefits, but a pilot with 20 years of service is eligible for a full military retirement.

20 Military members who joined the Uniformed Services after January 1st, 2018, or those who opted-in during the opt-in period are eligible for the BRS. The BRS consists of two parts: a defined contribution and a defined benefit. The defined contribution consists of a tax-preferred retirement account where the Government automatically makes a monthly contribution equal to 1% of the servicemember’s base pay. After serving for two years, the servicemember becomes eligible to receive an additional 4% matching from the Government. Unlike traditional military retirement benefits, the servicemember does not have to fulfill any minimum service requirements in order to realize these benefits. Regardless of time served, the member can take this tax-preferred retirement account with them when they separate. Members become eligible for the defined benefit component upon reaching twenty years of active duty service. The defined benefit pays 2.0% times the total years of service times the average of the members highest 36 months of base pay per month.
Operational Realities

Military pay, ADSCs and retirement benefits give a framework to pilots’ retention decisions. Pilots can only separate when they are eligible and will likely compare the financial implications of separation, retirement, and civilian employment. Within this framework, certain operational realities also influence pilots’ quality of life and quality of service, and therefore their retention behavior. These realities include operations tempo, MDS, deployment schedule and the duty stations where pilots serve. Each factor will be discussed in this order.

Operations Tempo

Operations tempo refers to the speed of operations at a given base, unit or community during a set period of time. Castro and Adler construct operations tempo in three main components: daily workload, training load, and deployment load (Castro and Adler, 2000). For pilots, daily workload includes local flying, additional duties, and daily time spent in the squadron. Training load includes the quantity and intensity of temporary duty (TDY) flying, and deployment load would consist of the quantity and intensity of deployments. Operations tempo affects retention decisions because it is a major contributor to pilot QoL and QoS.

The direction in which operations tempo affects QoL and QoS is more nuanced, because servicemembers assert a wide range of QoL and QoS preferences. For some airmen, an ideal QoL and QoS is rooted in long days in the squadron, frequent TDYs, and regular squadron functions. For this airman, high operations tempos will maximize their QoL and QoS. However, other airmen prefer spending more time with their family, and would prefer a more stable work-life balance, even if it means flying less. The same operational tempo described for Airman A would likely burn-out Airman B, providing a poor QoL. Due to differences in preferences between airmen, the relationship between operations tempos and retention will be variable (Sweeney, 2015).

MDS

The type of aircraft pilots fly likely affects their retention decisions in multiple ways. First, a pilot’s assigned MDS determines where they are most likely to be stationed. Each MDS is operated at only a subset of installations. Naturally pilots trained to operate each MDS are more likely to be stationed at installations operating those MDS. Second, units operating each MDS are prone to their own operations tempos. Many units of the same MDS deploy at similar rates, complete TDYs at similar rates, and fly similar rates at home station. The operations tempo of two F-15E squadrons are likely to have more in common than the operations tempos of an F-22 squadron and an F-16 squadron. Third, there may be some sorting on unobservables that occurs at the MDS level. For example, the highest performing pilots in UPT have the best chance of being assigned a fifth-generation aircraft. It is possible that performance in UPT, and therefore assignment of MDS, could parallel certain personal characteristics like aptitude, or commitment.
to the Air Force, that are also correlated with retention. This analysis does not explore this possible relationship. However it is noteworthy, and could be a topic for future analysis.

As was discussed with operations tempo, the effect of any specific airframe on QoL and QoS likely varies from pilot to pilot. Some pilots will be most fulfilled flying fifth generation fighters, while others are best suited to be T-38 instructors at an AETC base. Neither is superior, but each pilot’s distance from their perceived ideal circumstance will affect retention decisions.

**Basing**

This dissertation is primarily concerned with how the installations in the USAF basing posture affect fighter pilot retention. The other retention considerations discussed in this section are needed to model pilots’ retention decisions, but installations’ effects are the focus of this analysis. The installations where pilots serve influence their QoL and QoS. The location of a pilot’s service determines where they live, where their spouses work, where their children go to school, the healthcare their family has access to, and many other QoL contributors. Installations also determine the quality of the facilities the pilot uses professionally that impact their QoS. The quality and availability of each of these basing determinants is not uniform across the USAF basing posture, therefore where a pilot is stationed has profound implications for themselves and their families, and likely affects their retention behavior.

As with operations tempos, pilots have different basing preferences that may make drawing sweeping conclusions about base quality challenging. Some pilots may find the lifestyle offered by Luke AFB appealing, while others may prefer Elmendorf AFB. Moreover, some pilots are members of large families with a unique set of priorities, while others are single, without any dependents. Nonetheless the installation a pilot is assigned to determines numerous QoL and QoS contributors that affect retention decisions.

**Challenges**

As mentioned in previous sections, the individual differences between one pilot and another make analyzing retention decisions challenging. In a perfect world everything related to a pilot’s assignment and their retention decisions would be included in retention models. The data that would be needed to do just that simply doesn’t exist. This data includes pilots retention intentions, personal desires, professional desires, basing preferences, MDS preferences, ability, perceived likelihood of promotion, assignment preferences and many more. Possible solutions to this problem will be discussed in later chapters. However, the covariates included in the model used in this dissertation attempt to minimize these endogeneity concerns as much as possible with the data available.
Modeling Installation-Effects

This section will describe the value-added model used throughout the remainder of this dissertation. This model builds on the theoretical understanding of pilot retention decisions described in the previous section and estimates installations’ effects on fighter pilots’ retention decisions.

The Model

This dissertation’s model for pilot retention combines two prevailing theories from the literature and includes each of the retention factors described in the previous section. The first, and more traditional view of pilot retention, asserts that pilots make retention decisions primarily based on the opportunities they face at the end of their ADSC. This line of thinking identifies civilian airline hiring as the dominant force driving pilot retention. Many experts agree that when the airlines are hiring, there is little the Air Force can do to retain its pilots.\textsuperscript{21} Pilots will leave the Air Force in droves for careers flying for commercial airlines. Proponents of this model of pilot retention suggest that financial incentives are the best way to combat low pilot retention.

The second, less widely held model of pilot retention behavior asserts that retention decisions are more closely related to what happens during a pilot’s ADSC than the opportunities available to them after their ADSC. Advocates for this theory believe that the QoL and QoS aircrew and their families experience while on active duty can “push” servicemembers out of the Air Force. A QoL- and QoS-centric explanation for pilot retention decisions suggests that measures like decreasing operations tempos, decreasing PCS frequency, increasing the quality of local schools, and increasing the opportunities for spousal employment will have more of an effect on pilot retention than a bonus.\textsuperscript{22} The model used in this dissertation combines these two theories, in addition to capitalizing on predictive administrative data.

The VAM employed in this dissertation models retention decisions such that the likelihood that pilot \( i \), assigned to installation \( b \), facing a retention decision in year \( t \) will be retained, is equal to \( R_{ibt} \). The model uses a cohort of relevant control variables to compare the retention decisions of similar pilots making retention decisions at different installations. It is a function of:

- \( X_t \), a vector of administrative controls including sex, race, and commissioning source.
- \( C_{it} \), a vector of time varying controls including days deployed under current ADSC, retirement eligibility, MDS, rank, whether an assignment is a flying or staff position, number of children, and marital status.
- \( \mu_b \), base fixed-effects
- \( \gamma_t \), year fixed-effects
- \( \varepsilon_{ibt} \) the error term.


\textsuperscript{22} See Stahl (2014), Mintz (2014), and Carson (2017) among others.
Such that:
\[ R_{lti} = \alpha X_i + \beta C_{lt} + \mu_t + \gamma_l + \epsilon_{lti} \]

Installations' effects on pilot retention are estimated using a single-level fixed-effects model. This model is uniquely configured in the sense that the treatment effects are captured in the base fixed-effects coefficients. In traditional fixed-effects models, it is not possible to estimate the coefficient of each fixed-effect due to overparameterization stemming from linear dependence between independent variables. It is standard practice to omit one dummy variable of each type of fixed-effect in order to avoid this situation. In models where fixed effects are used as controls, and the coefficients of concern involve other time-varying variables, designating a leave-out variable is less important, as the desired treatment effects are invariant to different parameterizations. Routinely the fixed-effect coefficients are not calculated, and are “absorbed” during the within-subjects transformation (Mihaly, 2010).

In models where the effect of interest is the fixed-effect coefficients, designating a leave-out dummy variable is problematic. Doing so renders coefficients dependent on model formulation and muddies the interpretation of the treatment effects. To remedy this shortcoming, installation fixed-effects are measured relative to the effect of an average installation, rather than a designated leave-out installation. Technically this is implemented by constraining the fixed-effects coefficients to sum to zero (Mihaly, 2010).

Calculating installation fixed-effects in this way estimates each installation’s effect on the retention behavior of pilots stationed at that base, relative to an “average installation” during a given time period. This metric will be used as the primary indicator of each installation’s effect on retention behavior throughout the remainder of this analysis. Each fixed-effect coefficient represents pilots’ likelihood of retention relative to an average installation within a set time period. The time periods used throughout the remainder of this dissertation range from one to twenty years.

Assumptions

The key assumption underpinning this model is that after accounting for the control variables described above there are no systemic differences between pilots stationed at different installations that would make pilots assigned to one installation more likely to be retained/separate than pilots assigned to another. When these conditions are met, this dissertation generates statistically consistent estimates of installations’ effects on pilot retention. The remainder of this section will discuss conditions straining the existence of these conditions, and steps taken to mitigate their influence.

Fighter pilots’ assignments are functions of their qualifications and the needs of the Air Force. The MDS pilots are trained to operate are one of the most binding considerations in their assignment process. Pilots assigned to flying positions are only stationed at installations that operate the MDS they are qualified to operate. For example, an F-15C pilot will be stationed at an installation hosting F-15Cs, not F-16s. If pilots operating certain MDS are more likely to
separate than others, and the effect is not addressed, this could affect the consistency of the model’s estimates.

The magnitude of a potential relationship between pilots’ MDS assignment and retention outcomes is minimized by the pseudo-randomness of MDS assignments. Pilots are assigned MDS in a dynamic process based on the pilot’s performance in UPT, the needs of the Air Force, and the pilot’s preferences. At the end of UPT, the Air Force matches a UPT class of X number of pilots with X number of MDS assignments. Pilots are then matched with MDS assignments based on their graduation ranking and preferences. For example, the top graduate of each UPT class is given first choice of the MDS assignments made available to their class of UPT graduates. The second highest ranked graduate is then given their choice of the remaining assignments. UPT graduates do not influence which MDS assignments are made available to their class, and the assignments available to each class vary considerably. This preserves the pseudo-randomness of the MDS assignment process.

Despite this pseudo-randomness, it is possible that a relationship between MDS assignment, installation assignment, and retention outcomes could exist. Including MDS as a control variable in the model prevents this relationship from affecting estimates of installation effects.

Pilots’ ability to influence their next assignment could also limit the statistical consistency of estimated installation-effects. Pilots’ agency over their next assignment likely increases with rank. As pilots progress in the rank structure, they become eligible for a wider range of assignments and possess more social capital within the assignment system that could give them more agency in their next assignment. If this is true, and senior pilots are more likely to receive installation assignments that align with their preferences, this could systematically affect senior pilots’ retention outcomes. However, even if this were the case, it isn’t immediately apparent the directionality of its effect on retention. Senior pilots may be just as likely to position themselves for separation as an extended active duty career.

The model accounts for these concerns by including rank as a control variable. Admittedly, this is a coarse representation for the phenomena. Likely a pilot’s ability to influence their next assignment doesn’t vary cleanly with rank, and a higher fidelity instrument would be needed to better capture these effects. As a result, in proportion with pilots’ uncontrolled for ability to influence their next assignment, installation-effects estimates are more statistically consistent when calculated using retention data from junior aviators than those of more senior pilots.

The Air Force’s transition to the Talent Marketplace assignment system also complicates the model’s ability to generate statistically consistent estimates of installation effects. Prior to Summer 2018, in absence of Talent Marketplace, fighter pilots had relatively little control over their assignments. This pseudo-randomness minimizes the likelihood that pilots with similar retention proclivities could systematically sort to certain installations. However, the Talent Marketplace is an attempt by the Air Force to give pilots more agency in their assignments, and in so doing opens the door for the type of sorting that could invalidate this model (Bailey, 2019).
Talent Marketplace’s consequences on this model’s ability to estimate installation effects are twofold. First, the installation effects calculated using retention decisions made after Summer 2018 should be interpreted with caution. It’s unclear when individual pilots received access to Talent Marketplace, given its phased rollout. During the transition some pilots made retention decisions with traditional limited agency, meanwhile other experienced the increased agency experienced provided by the new platform. Second, to continue using value added models like the one described in this dissertation after the transition to Talent Marketplace, pilots’ agency will need to be controlled for. The “Opportunities for Future Analysis” section in Chapter 7 discusses how this could be done in further detail.

Data

This section will familiarize readers with the origin and structure of the data used in this dissertation. It will also share descriptive statistics for each of the control variables included in the model.

Sources and Structure

The data used in this dissertation originates from two Air Force Personnel Center (AFPC) datasets describing pilots’ careers: Military Personnel Data System (MilPDS) monthly officer extracts and Deliberate and Crisis Action Planning and Execution Segments (DCAPES). The data is organized such that each observation represents a “decision point” in a pilot’s career. At these points pilots choose to either extend their active duty careers by signing a new ADSC, separate from active duty service, or retire from the Air Force.

Descriptive Statistics

The data used in this dissertation contains 14,389 decision points that describe the careers of 6,140 active duty fighter pilots. In an effort to focus on pilots in flying positions, pilots beneath the rank of O-3 and above the rank of O-6 are excluded. Lieutenants are primarily signing their initial ADSC following the successful completion of UPT. These are not the retention decisions this dissertation is concerned with, therefore they are omitted from the data. In the same vein, pilots ranking O-6 and above are almost certainly beyond the flying phase of their careers, and therefore are also outside the scope of this analysis.

Table 4.4 describes the distribution of the number of decision points made by pilots of each rank. 26% of decision points are made by Captains, 44% by Majors, and 28% by Lieutenant Colonels. The average number of decision points made by each pilot also increases with rank. For example, Captains, have made 1 ADSC decision, on average, and 1/3 of these captains have made 2 decisions. Likewise, the average number of ADSC decisions made by Majors are approximately 2.2, and by LtCols, 4.2.
Table 4.4 Pilots and Decision Points by Rank

<table>
<thead>
<tr>
<th>Rank</th>
<th>Decision Points</th>
<th>Av Retention Decision Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>Percent</td>
</tr>
<tr>
<td>O-3</td>
<td>3,838</td>
<td>26.67</td>
</tr>
<tr>
<td>O-4</td>
<td>6,462</td>
<td>44.91</td>
</tr>
<tr>
<td>O-5</td>
<td>4,089</td>
<td>28.42</td>
</tr>
<tr>
<td>Total</td>
<td>14,389</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: The average number of retention decisions made by pilots of each rank are calculated using data from pilots commissioned after Jan 1, 1996.

Source: AFPC, 2019

Table 4.5 demonstrates the distribution of sex and race across pilots included in this analysis, as well as the average number of retention decisions made by pilots of each race as Captains-LtCols. Fighter pilots are predominantly white and male. Pilots of each race make approximately the same number of retention decisions. As Captains, Majors and LtCols white pilots made 2.57 retention decisions on average. Meanwhile Asian/Pacific Islander, Black, and Hispanic pilots made 2.46, 2.40, and 2.67 retention decisions on average during the same parts of their careers.

Table 4.5 Pilots and Decision Points by Rank

<table>
<thead>
<tr>
<th>Race</th>
<th>Pilots</th>
<th>Decision Points</th>
<th>Average Total Num Retention Decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Per Pilot</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>&lt;10</td>
<td>81</td>
<td>2.46</td>
</tr>
<tr>
<td>Black</td>
<td>&lt;10</td>
<td>76</td>
<td>2.40</td>
</tr>
<tr>
<td>Hispanic</td>
<td>&lt;10</td>
<td>114</td>
<td>2.67</td>
</tr>
<tr>
<td>Other</td>
<td>&lt;10</td>
<td>232</td>
<td>2.89</td>
</tr>
<tr>
<td>Unknown</td>
<td>&lt;10</td>
<td>88</td>
<td>2.56</td>
</tr>
<tr>
<td>White</td>
<td>92</td>
<td>5,444</td>
<td>2.57</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>6,035</td>
<td>253</td>
</tr>
</tbody>
</table>

Note: Male pilots average making 2.59 retention decisions while female pilots made 2.25 retention decisions on average. The average number of retention decisions made by pilots of each race are calculated using data from pilots commissioned after Jan 1, 1996.

Source: AFPC, 2019

The pilots studied in this dissertation were commissioned via many different commissioning sources. Table 4.6 details the quantity of pilots commissioned via each commissioning source, as well as the average number of retention decisions they make. The Service Academies commissioned the most fighter pilots out of any other commissioning source, producing 2,471. Unfunded four-year ROTC billets produced the second most pilots commissioning 855, closely followed by funded four-year ROTC billets with 630 fighter pilots.
The average number of retention decisions made by pilots commissioned via each commissioning source ranged from 2.22 to 2.75 retention decisions. Non-distinguished graduate service academy graduates made an average of 2.66 retention decisions. Unfunded 4-year ROTC commissions, the second largest contingent, averaged only 2.29 retention decisions over the course of their careers. Funded 4-year ROTC commissions behaved more like Academy graduates, averaging 2.65 retention decisions.

### Table 4.6 Pilots and Decision Points by Commissioning Source

<table>
<thead>
<tr>
<th>Commissioning Source</th>
<th>Pilots</th>
<th>Decision Points</th>
<th>Average Number Retention Decisions Per Pilot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Freq.</td>
<td>Percent</td>
<td>Freq.</td>
</tr>
<tr>
<td>Service Academy</td>
<td>2,471</td>
<td>40.24</td>
<td>6,014</td>
</tr>
<tr>
<td>4 Yr ROTC</td>
<td>855</td>
<td>13.93</td>
<td>1,840</td>
</tr>
<tr>
<td>4 Yr ROTC FAG</td>
<td>630</td>
<td>10.26</td>
<td>1,535</td>
</tr>
<tr>
<td>OTS</td>
<td>559</td>
<td>9.1</td>
<td>1,129</td>
</tr>
<tr>
<td>Service Academy DG</td>
<td>436</td>
<td>7.1</td>
<td>1,110</td>
</tr>
<tr>
<td>4 Yr ROTC FAG DG</td>
<td>421</td>
<td>6.86</td>
<td>1,041</td>
</tr>
<tr>
<td>2 Yr ROTC</td>
<td>209</td>
<td>3.4</td>
<td>430</td>
</tr>
<tr>
<td>4 Yr ROTC DG</td>
<td>159</td>
<td>2.59</td>
<td>405</td>
</tr>
<tr>
<td>OTS DG</td>
<td>145</td>
<td>2.36</td>
<td>289</td>
</tr>
<tr>
<td>2 Yr ROTC FAG</td>
<td>98</td>
<td>1.6</td>
<td>239</td>
</tr>
<tr>
<td>2 Yr ROTC FAG DG</td>
<td>63</td>
<td>1.03</td>
<td>147</td>
</tr>
<tr>
<td>2 Yr ROTC DG</td>
<td>60</td>
<td>0.98</td>
<td>135</td>
</tr>
<tr>
<td>Other</td>
<td>34</td>
<td>0.55</td>
<td>75</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,140</td>
<td>100</td>
<td>14,389</td>
</tr>
</tbody>
</table>

Note: FAG is an abbreviation for Financial Assistance Grant. It signifies the individual received an ROTC scholarship. DG is an abbreviation for Distinguished Graduate. The average number of retention decisions made by pilots of each commissioning source are calculated using data from pilots commissioned after Jan 1, 1996.

Source: AFPC, 2019

The fighter pilots included in this dissertation operate a wide variety of MDS. Table 4.7 details the number of decision points made by pilots of each MDS, as well as the average number of retention decisions per pilot, average number of days completing exercise operations per ADSC, and the average number of days spent completing contingency operations per ADSC by MDS. The column describing the average number of retention decisions per pilot represents the average number of retention decisions made over pilots’ entire careers, by pilots who flew each MDS. It is important to note that many pilots operate multiple MDS over the course of their careers. In this column, a pilot is counted as an F-16 pilot if they ever flew the F-16. The columns representing the average days spent completing exercise and contingency operations are calculated by summing the days a pilot spent completing exercise or contingency operations since their last retention decision. In these columns, a pilot’s MDS is designated based on the MDS in which the pilot most recently logged flight hours.
F-16 pilots made more retention decisions than pilots operating any other MDS, making 29% of the total number of decisions made. T-38 pilots made the second most decisions with 14% of the total number of decisions made. F-15C, F-15E and A-10 each made roughly 10% of the total decisions. There was relatively little variation in the number of decision points made by pilots of each type over their respective careers. Pilots of all major training and fighter aircraft averaged approximately two and a half retention decisions over their respective careers.

Table 4.7 Decision Points by MDS

<table>
<thead>
<tr>
<th>MDS</th>
<th>Freq.</th>
<th>Percent</th>
<th>Decision Points</th>
<th>Average Number Retention Decisions Per Pilot</th>
<th>Average Days Exercise Per ADSC</th>
<th>Average Days Contingency Per ADSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-16</td>
<td>4,293</td>
<td>29.84</td>
<td>2.51</td>
<td>28.61</td>
<td>76.27</td>
<td></td>
</tr>
<tr>
<td>T-38</td>
<td>2,089</td>
<td>14.52</td>
<td>2.58</td>
<td>11.06</td>
<td>54.42</td>
<td></td>
</tr>
<tr>
<td>UNK</td>
<td>1,830</td>
<td>12.72</td>
<td>2.13</td>
<td>2.67</td>
<td>24.55</td>
<td></td>
</tr>
<tr>
<td>F-15C</td>
<td>1,702</td>
<td>11.83</td>
<td>3.01</td>
<td>28.63</td>
<td>52.52</td>
<td></td>
</tr>
<tr>
<td>F-15E</td>
<td>1,378</td>
<td>9.58</td>
<td>2.76</td>
<td>22.19</td>
<td>113.16</td>
<td></td>
</tr>
<tr>
<td>A-10</td>
<td>1,332</td>
<td>9.26</td>
<td>2.52</td>
<td>21.45</td>
<td>102.52</td>
<td></td>
</tr>
<tr>
<td>F-22</td>
<td>609</td>
<td>4.23</td>
<td>2.23</td>
<td>31.07</td>
<td>100.17</td>
<td></td>
</tr>
<tr>
<td>RPA</td>
<td>280</td>
<td>1.95</td>
<td>2.16</td>
<td>13.33</td>
<td>79.03</td>
<td></td>
</tr>
<tr>
<td>T-6</td>
<td>260</td>
<td>1.81</td>
<td>2.47</td>
<td>7.33</td>
<td>68.42</td>
<td></td>
</tr>
<tr>
<td>F-35</td>
<td>253</td>
<td>1.76</td>
<td>1.51</td>
<td>17.92</td>
<td>38.95</td>
<td></td>
</tr>
<tr>
<td>T-37</td>
<td>222</td>
<td>1.54</td>
<td>3.10</td>
<td>16.43</td>
<td>48.64</td>
<td></td>
</tr>
<tr>
<td>F-117</td>
<td>141</td>
<td>0.98</td>
<td>3.50</td>
<td>19.34</td>
<td>60.15</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>14,389</td>
<td>100</td>
<td>2.58</td>
<td>20.44</td>
<td>69.36</td>
<td></td>
</tr>
</tbody>
</table>

Note: The MDS a pilot operates can change over time. The average number of retention decisions made by each type of pilot is calculated for all pilots who flew each type of aircraft. For example, 4.01, the average number of retention decisions made by F-16 pilots, represents the average number of retention decisions made by pilots who flew the F-16 during their career. This caveat is most relevant to T-6, T-37, and T-38 pilots, as they did not fly this aircraft for the majority of their flying careers.

The average number of retention decisions made by pilots of each MDS are calculated using data from pilots commissioned after Jan 1, 1996.

Source: AFPC, 2019

Table 4.8 also documents the number of days pilots of each MDS spent executing exercise and contingency operations per ADSC. The pilots of operational fighter aircraft spent considerably more days completing exercises and contingency operations than pilots operating training aircraft. Among operational fighter aircraft, F-15E, A-10 and F-22 pilots spent the most days supporting contingency operations, with each averaging over 100 days per ADSC. F-16, F-15C and F-35 pilots spent considerably less days supporting contingency operations per ADSC.
Table 4.8 Comparing Pilots Who Deployed to Pilots Who Did Not

<table>
<thead>
<tr>
<th>Did not Participate in Contingency Operations</th>
<th>Did Participate in Contingency Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Num decision points</td>
<td>9133</td>
</tr>
<tr>
<td>Av Num Days Deployed</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>189.88</td>
</tr>
</tbody>
</table>

Source: AFPC, 2019

It is also noteworthy that pilots deployed in support of contingency operations in only one third of all ADSCs included in this study. Of those who did, the average length of those deployments was 189 days. Figure 4.2 depicts the distribution deployment lengths. The distribution appears to be roughly normal, with a long tail on the right-side capturing pilots deployed for exceptionally high numbers of days.

Figure 4.2 Time Deployed For Those Who Have Deployed

![Figure 4.2 Time Deployed For Those Who Have Deployed](source:AFPC,2019)

Pilots’ unique responses to the array of ADSCs, retention incentives, and career opportunities available to them leads to variation in the number of retention decisions pilots make during their careers. Pilots making retention decisions from 2000 to 2019 who were commissioned after January 1st 1996 made an average of 2.58 decision points before separating from active duty. Figure 4.3 details the number of pilots making 1-10 decision points over the course of their careers.

Figure 4.3 Number of Pilots Making 1-10 Decision Points

![Figure 4.3 Number of Pilots Making 1-10 Decision Points](source:AFPC,2019)
The number of decision points any pilot makes has a complex relationship with retention intentions. Intuitively, pilots who have survived more decision points would be signaling strong commitment to the Air Force. But due to the nature of the AvB, this may not be the case. As described in earlier sections, pilots are eligible for the AvB after completing their initial ADSC from UPT. The AvB offers increasing bonus amounts for pilots who are willing to sign longer contracts. Therefore a pilot who finishes their ADSC and is confident they will serve until retirement would likely sign a nine or more year contract. This means they may only make 2 decision points over the course of their career despite being the most committed to serving full military careers.

Retirement eligibility and staff assignments are also controlled for in the model used in this dissertation. Table 4.9 documents the number of decision points made by retirement eligible/ineligible pilots as well as the number of retention decisions made by pilots serving in staff vs non-staff assignments. The majority of retention decisions were made by non-retirement eligible pilots serving in non-staff assignments. The likelihood of a retention decision being made by a retirement eligible and/or staff pilot increased with rank.

---

23 Pilots were coded as serving in either staff or non-staff assignments at the time of their retention decision in accordance with their Duty ADSC.
Table 4.9 Retirement Eligibility and Staff Assignments by Rank

<table>
<thead>
<tr>
<th>Rank</th>
<th>Retirement Eligible</th>
<th>Staff Position</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>O-3</td>
<td>&lt;10</td>
<td>3,834</td>
</tr>
<tr>
<td>O-4</td>
<td>236</td>
<td>6,226</td>
</tr>
<tr>
<td>O-5</td>
<td>1,201</td>
<td>2,888</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>12,948</td>
</tr>
</tbody>
</table>

Source: AFPC, 2019

Pilots’ family situations are also controlled for in this retention model, specifically the pilots’ marriage status and number of children living at home. Table 4.10 describes the marital status and the average number of children by rank. Most retention decisions were made by married pilots. As pilots increase in rank, they are more likely to have more children, and less likely to be single.

Table 4.10 Marriage Status and Average Number of Children by Rank

<table>
<thead>
<tr>
<th>Rank</th>
<th>Single</th>
<th>Married</th>
<th>Divorced</th>
<th>Widowed</th>
<th>Legally Separated</th>
<th>Av. Num Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-3</td>
<td>529</td>
<td>3,204</td>
<td>104</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>0.82</td>
</tr>
<tr>
<td>O-4</td>
<td>379</td>
<td>5,852</td>
<td>229</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>1.37</td>
</tr>
<tr>
<td>O-5</td>
<td>66</td>
<td>3,896</td>
<td>116</td>
<td>10</td>
<td>&lt;10</td>
<td>1.81</td>
</tr>
<tr>
<td>Total</td>
<td>974</td>
<td>12,952</td>
<td>449</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: AFPC, 2019

Summary

This chapter introduced a new method capable of furthering the Air Force’s understanding of pilot retention. It first introduced value-added modeling, then discussed a theoretical framework for pilot retention decisions, formulated a value-added model to estimate installations’ effects on pilot retention, and introduced the data that will be analyzed throughout the remainder of this dissertation. The following chapter will discuss the results of applying the retention VAM, to suggest where improvements in retention policy could be made.
5. Installations’ Effects on Fighter Pilot Retention

This chapter demonstrates an application of a novel value-added model to improve the Air Force’s understanding of fighter pilot retention. With a deepened understanding of installations’ effects on fighter pilot retention outcomes, USAF policymakers could leverage basing decisions made through the Strategic Basing Process to shape pilot retention outcomes. This chapter begins by discussing the findings of a value-added model used to investigate installations’ contributions to the likelihood that a pilot is retained when faced with a retention decision. These installation-effects are estimated for installations of differing missions, as well as different types of pilots. Estimated installation effects will also be compared to the communities that surround each installation in an effort to demonstrate pilots revealed basing preferences.

Does the Air Force’s basing posture affect pilot retention?

If the Air Force’s basing posture is a viable policy lever to improve pilot retention, there must be a relationship between basing policy and pilot retention. This section demonstrates one way to measure this relationship by employing the VAM introduced in the previous chapter. This model uses fixed-effects terms to capture installations’ additional contribution to the likelihood that a pilot making a retention decision while stationed there will be retained, relative to an average installation. Throughout the remainder of this dissertation, the coefficients of installation’s fixed-effects terms will be referred to as “additional likelihood of retention,” or ALR values. For example, a pilot making a retention decision while stationed at Columbus AFB is 7.6% less likely to be retained than if that pilot were making the same decision at an average retention base.

Figure 5.1 depicts the ALR values for each Air Force active duty installation where more than two hundred retention decisions have been made by fighter pilots since 2000. Installations’ are plotted from left to right in accordance with increasing ALR values. Figure 5.1 demonstrates that where pilots are stationed while making retention decisions matters. From 2000-2019 pilots making retention decisions at the lowest ALR installation were 16.7% less likely to be retained than pilots assigned to the highest ALR installation. Interestingly, the installation’s ALR values appear to be correlated with the mission conducted at each base. Many of the lowest ALR installations are training bases, with many operational installations earning average ALR values, and foreign and unique mission installations earning the highest ALR values. The following chart shows these categories more clearly. There are exceptions to this clustering by mission, but analyzing average ALR values within these categories confirms the trend.
Table 5.1 displays each installation’s ALR value from 2000-2019, organized by mission type. Installations are sorted into four primary categories in accordance with the clustering observed in Figure 5.1: training, operational, foreign and unique mission. Installations categorized as training bases host either UPT, IFF, or FTU units. Operational installations host units with an assigned wartime mission, also known as “combat-coded” squadrons. This excludes squadrons completing training, operational test, and evaluation missions. Foreign installations are those located outside the United States. Creech AFB, Edwards AFB, The Pentagon, and Maxwell AFB are designated unique mission installations because they host a unique subset of missions and pilots. Creech AFB is a hub for RPA pilots, Edwards AFB hosts the Air Force’s Test Pilot School, The Pentagon is an administrative hub, and Maxwell AFB hosts Air Command and Staff College.

Table 5.1 lists the ALR values for pilots making retention decisions while assigned to each installation. Training installations have the lowest ALR values of any installation type, averaging an ALR value of -4.9%. Operational installations have the second lowest ALR values, averaging
2.0%. Foreign and unique mission installations average significantly higher ALR values, at 5.0% and 6.1% respectively.

In addition to between base mission types, meaningful variation in ALR values also exists within these categories. A pilot’s additional likelihood of retention when making retention decisions at training installations range from -7.6% at Columbus AFB to 0.5% at Laughlin AFB. This is an 8% difference in ALR values between two UPT installations. Variation within FTU installations is somewhat less dramatic ranging from -7.1% at Tyndall AFB to -0.1% at Seymour-Johnson AFB, a difference of 7.2%.

Equivalent variation also exists within operational, foreign and unique mission installations. Pilots making retention decisions at Hill AFB, the lowest ALR operational installation, are 7.1% less likely to be retained than pilots at Eielson AFB, the highest ALR operational installation. Pilots at RAF Lakenheath, the lowest ALR foreign installation are 6.2% less likely to be retained than pilots at Misawa AB. Lastly pilots at The Pentagon, the lowest ALR unique mission installation, are 6.6% less likely to be retained than those at Maxwell AFB, the highest ALR unique mission installation. This variation within installation mission type demonstrates that mission type may be an important component of an installation’s impact on pilots’ retention decision, but it is not solely predictive of retention behavior.

Individual installations’ ALR values range from -7.6% at Columbus AFB to 9.3% at Maxwell AFB. Seven installations experienced ALR values more than one standard deviation below mean installation-effects: Columbus, Tyndall, Randolph, Luke, Hill, Nellis and Eglin AFBs. Hill AFB is the only non-training base to do so. Seven installations received ALR values greater than one standard deviation above mean installation-effects: Creech AFB, Spangdahlem AB, Aviano AB, Osan AB, Edwards AFB, Maxwell AFB, and Misawa AB. Of these installations, four are foreign installations, and three are unique mission installations.

<table>
<thead>
<tr>
<th>Training Inst.</th>
<th>ALR (%)</th>
<th>Operational Inst.</th>
<th>ALR (%)</th>
<th>Foreign Inst.</th>
<th>ALR (%)</th>
<th>Unique Mission Inst.</th>
<th>ALR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbus</td>
<td>-7.6</td>
<td>Hill</td>
<td>-5.8</td>
<td>Lakenheath</td>
<td>2.8</td>
<td>Pentagon</td>
<td>2.7</td>
</tr>
<tr>
<td>Tyndall</td>
<td>-7.1</td>
<td>Holloman</td>
<td>-3.3</td>
<td>Kunsan</td>
<td>2.9</td>
<td>Creech</td>
<td>5.1</td>
</tr>
<tr>
<td>Randolph</td>
<td>-6.8</td>
<td>Shaw</td>
<td>-3.1</td>
<td>Kadena</td>
<td>3.0</td>
<td>Edwards</td>
<td>7.1</td>
</tr>
<tr>
<td>Luke</td>
<td>-6.2</td>
<td>Langley</td>
<td>-2.1</td>
<td>Spangdahlem</td>
<td>5.5</td>
<td>Maxwell</td>
<td>9.3</td>
</tr>
<tr>
<td>Nellis</td>
<td>-5.6</td>
<td>Elmendorf</td>
<td>-1.1</td>
<td>Aviano</td>
<td>5.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eglin</td>
<td>-5.3</td>
<td>Mtn Home</td>
<td>-0.7</td>
<td>Osan</td>
<td>6.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>-2.7</td>
<td>Moody</td>
<td>-0.1</td>
<td>Misawa</td>
<td>9.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheppard</td>
<td>-2.2</td>
<td>Eielson</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vance</td>
<td>-1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seymour-J.</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laughlin</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>-4.9</td>
<td></td>
<td>-2.0</td>
<td>5.0</td>
<td></td>
<td>6.1</td>
<td></td>
</tr>
</tbody>
</table>
Table 5.2 lists the additional number of pilots who would be expected to separate/be retained at each installation every five years if each installation demonstrated average retention behavior. These values are calculated by multiplying each installation’s ALR value by the average number of retention decisions made at that installation every five years. Positive values describe situations where the installation currently exhibits below average retention rates, therefore increasing to average retention levels would result in more pilots being retained at those installations. Negative values describe installations with above average retention rates, therefore reverting to mean retention behavior would result in fewer pilots being retained at these bases.

<table>
<thead>
<tr>
<th>Training Base</th>
<th>n</th>
<th>Operational Base</th>
<th>n</th>
<th>Foreign Base</th>
<th>n</th>
<th>Unique Mission Base</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbus</td>
<td>6</td>
<td>Hill</td>
<td>6</td>
<td>Lakenheath</td>
<td>-3</td>
<td>Pentagon</td>
<td>-3</td>
</tr>
<tr>
<td>Tyndall</td>
<td>10</td>
<td>Holloman</td>
<td>4</td>
<td>Kunsan</td>
<td>-2</td>
<td>Creech</td>
<td>-3</td>
</tr>
<tr>
<td>Randolph</td>
<td>10</td>
<td>Shaw</td>
<td>4</td>
<td>Kadena</td>
<td>-2</td>
<td>Edwards</td>
<td>-7</td>
</tr>
<tr>
<td>Luke</td>
<td>18</td>
<td>Langley</td>
<td>4</td>
<td>Spangdahlem</td>
<td>-4</td>
<td>Maxwell</td>
<td>-10</td>
</tr>
<tr>
<td>Nellis</td>
<td>16</td>
<td>Elmendorf</td>
<td>1</td>
<td>Aviano</td>
<td>-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eglin</td>
<td>9</td>
<td>Mtn Home</td>
<td>1</td>
<td>Osan</td>
<td>-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>5</td>
<td>Moody</td>
<td>0</td>
<td>Misawa</td>
<td>-5</td>
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<td></td>
</tr>
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<tr>
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<tr>
<td>Seymour-J.</td>
<td>0</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td><strong>Average</strong></td>
<td>8</td>
<td>2</td>
<td>-4</td>
<td>-6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: AFPC, 2019

These initial results demonstrate two primary things: first, significant variation in retention behavior exists across the USAF basing posture. This signals that where pilots are stationed when they make retention decisions matters concerning their retention outcomes. Second, with this in mind, the Air Force can use these preferences to deliver tailored, retention improving assignments to its pilots.

Utilizing all relevant policy levers to increase pilot retention is important because increasing pilot retention is the most efficient way to decrease pilot shortages. In their 2019 work titled “The Relative Cost Effectiveness of Retaining Versus Accessing Air Force Pilots,” Mattock, Asch, Hosek, and Boito demonstrate that increasing pilot retention is a substantially more cost-efficient way to close the pilot shortfall than increasing production. Producing new fighter pilots is far more expensive than incurring the elevated personnel costs associated with elevated pilot
retention and the more senior cadre of pilots it would entail. It costs approximately $5.6 million to produce 4\textsuperscript{th} generation fighter pilots and up to $10.9 million for more advanced 5\textsuperscript{th} generation fighter pilots. A more senior pool of fighter pilots will cost the Air Force more in base and retirement pay, but these increases pale in comparison to the costs of accessing new fighter pilots (Mattock et al., 2019).

**Basing Policy as a Tailored Retention Tool**

Pilots’ unique basing preferences provide opportunities for Air Force policymakers to improve the Service’s retention policy. As the Air Force learns more about pilots’ assignment preferences as officers continue to be paired with future assignments via the Talent Marketplace assignment system, the Service will know more about its pilots than ever before. Aligning goals and preferences could improve the Air Force’s ability to retain experienced pilots. This section demonstrates two examples of how basing assignments could be used as a tailored retention tool.

**Rank**

Mid-career pilots and senior pilots demonstrate differing retention behavior at some installations across the USAF basing posture. These discrepancies offer the Air Force unique opportunities to offer tailored, retention increasing assignments to pilots. For the purpose of this analysis, mid-career aviators are those ranking O-3, and senior pilots are those ranking O-4 and O-5. Table 5.3 details the ALR values for mid-career and senior aviators at each installation. Installations are organized by mission type and are listed in ascending order of senior pilots’ ALR scores. The ALR score for mid-career pilots at each installation is listed first in the column labeled MC, and the ALR score for senior pilots at each installation is listed second in the column labeled Senior. Installations where the difference in ALR values for mid-career and senior aviators is greater than 5% are highlighted in yellow.

For both mid-career and senior aviators, training installations averaged the lowest ALR values, followed by operational installations. Unique mission installations averaged the highest ALR values for mid-career pilots, whereas foreign installations averaged the highest ALR values for senior pilots. The continued presence of these trends reinforces their validity. Of all thirty installations included in this study, retention outcomes for mid-career and senior pilots were most dissimilar at the Pentagon. Mid-career pilots making retention decisions at the pentagon were 13.4% more likely to be retained than mid-career pilots at an average installation. Meanwhile, senior aviators making retention decisions at the Pentagon were only 1.4% more likely to be retained than pilots at an average installation. This inconsistency, and others like it, are examples of additional footholds the Air Force could exploit to issue its pilots tailored, retention improving assignments.

Mid-career and senior aviators also demonstrated different retention behavior at four training installations: Tyndall, Columbus, Eglin and Seymour-Johnson AFBs. Senior pilots were
considerably more likely to separate from each base than their more junior contemporaries. Senior pilots were also more likely to be retained at three foreign installations than mid-career pilots: Aviano, Osan and Misawa ABs.

Table 5.3 Base ALR Values for Mid-Career and Senior Pilots

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyndall</td>
<td>-2.4</td>
<td>-9.2</td>
<td>Hill</td>
<td>-6.3</td>
<td>-5.9</td>
<td>Spangd.</td>
<td>-4.2</td>
<td>-1.7</td>
<td>Pentagon</td>
<td>13.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Columbus</td>
<td>-1.8</td>
<td>-9.2</td>
<td>Holloman</td>
<td>-6.3</td>
<td>-2.8</td>
<td>Laken.</td>
<td>3.4</td>
<td>2.5</td>
<td>Creech</td>
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<td>5.6</td>
</tr>
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<td>Luke</td>
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<td>-7.1</td>
<td>Langley</td>
<td>-0.8</td>
<td>-2.8</td>
<td>Kunsan</td>
<td>3.4</td>
<td>2.5</td>
<td>Edwards</td>
<td>9.5</td>
<td>6.5</td>
</tr>
<tr>
<td>Randolph</td>
<td>-6.4</td>
<td>-7.1</td>
<td>Shaw</td>
<td>-4.7</td>
<td>-2.5</td>
<td>Kadena</td>
<td>5.1</td>
<td>2.8</td>
<td>Maxwell</td>
<td>-</td>
<td>8.3</td>
</tr>
<tr>
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<td>-6.3</td>
<td>Elmendorf</td>
<td>-1.4</td>
<td>-0.6</td>
<td>Aviano</td>
<td>1.7</td>
<td>7.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nellis</td>
<td>-4.5</td>
<td>-6.0</td>
<td>Mtn Home</td>
<td>-0.9</td>
<td>0.0</td>
<td>Osan</td>
<td>1.4</td>
<td>8.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
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<td>-3.0</td>
<td>Moody</td>
<td>-2.6</td>
<td>0.5</td>
<td>Misawa</td>
<td>4.6</td>
<td>11.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>-1.7</td>
<td>Eielson</td>
<td>-0.9</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vance</td>
<td>-4.5</td>
<td>-0.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seymour-J.</td>
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<td>-2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laughlin</td>
<td>0.2</td>
<td>0.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>-3.2</td>
<td>-5.5</td>
<td></td>
<td>-3.0</td>
<td>-2.3</td>
<td>3.3</td>
<td>5.9</td>
<td></td>
<td>8.2</td>
<td>5.5</td>
<td></td>
</tr>
</tbody>
</table>

Note: Installations where the difference in ALR values for mid-career and senior aviators is greater than 5% are highlighted in yellow. Averages are weighted based on the number of observations per base. Source: Original Analysis, 2020

Table 5.4 contextualizes these results by considering the number of retention decisions made at each installation. Table 5.4 lists the additional number of pilots who would be expected to be retained every five years if each installation demonstrated average retention behavior. Installations with more extreme retention behavior and large numbers of pilots making retention decisions the most to gain if pilots retention behavior changed to the mean.

Table 5.4 Additional Mid-Career and Senior Pilots to be Retained Under Average Retention Rates

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyndall</td>
<td>1.0</td>
<td>8.5</td>
<td>Hill</td>
<td>2.4</td>
<td>4.0</td>
<td>Spangd.</td>
<td>1.7</td>
<td>2.1</td>
<td>Pentagon</td>
<td>-1.4</td>
<td>-1.4</td>
</tr>
<tr>
<td>Columbus</td>
<td>0.3</td>
<td>5.9</td>
<td>Holloman</td>
<td>1.7</td>
<td>2.4</td>
<td>Laken.</td>
<td>-1.1</td>
<td>-0.9</td>
<td>Creech</td>
<td>-0.4</td>
<td>-2.6</td>
</tr>
<tr>
<td>Luke</td>
<td>3.0</td>
<td>14.4</td>
<td>Langley</td>
<td>0.3</td>
<td>4.0</td>
<td>Kunsan</td>
<td>-1.1</td>
<td>-0.9</td>
<td>Edwards</td>
<td>-1.4</td>
<td>-5.3</td>
</tr>
<tr>
<td>Randolph</td>
<td>0.9</td>
<td>9.8</td>
<td>Shaw</td>
<td>1.9</td>
<td>2.2</td>
<td>Kadena</td>
<td>-1.4</td>
<td>-1.5</td>
<td>Maxwell</td>
<td>-</td>
<td>-8.6</td>
</tr>
<tr>
<td>Eglin</td>
<td>0.0</td>
<td>8.5</td>
<td>Elmendorf</td>
<td>0.5</td>
<td>0.4</td>
<td>Aviano</td>
<td>-0.5</td>
<td>-3.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nellis</td>
<td>1.7</td>
<td>14.8</td>
<td>Mtn Home</td>
<td>0.3</td>
<td>0.0</td>
<td>Osan</td>
<td>-0.7</td>
<td>-8.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>1.8</td>
<td>4.1</td>
<td>Moody</td>
<td>0.9</td>
<td>-0.3</td>
<td>Misawa</td>
<td>-1.3</td>
<td>-3.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheppard</td>
<td>1.7</td>
<td>2.1</td>
<td>Eielson</td>
<td>0.2</td>
<td>-1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vance</td>
<td>0.8</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
It is worth noting that pilots’ ability to influence their next assignment likely increases with rank. As pilots increase social capital among the officer corps and become qualified for a more diverse set of assignments, both of which happen as they increase in rank, pilots may have more control over their next assignment. Such influence biases the VAM generated installation-effects. As such, the ALR values for mid-career officers are likely more statistically consistent estimates of installation effects.

**Children**

Pilots with children demonstrated different retention behavior than pilots without children at some installations across the USAF basing posture. This variation provides another opportunity for the Air Force to provide tailored, retention increasing assignments to pilots. Table 5.5 lists installations’ ALR values for pilots without (labeled NC) and with children (labeled C). As was the case with rank, retention trends remain consistent across installation types. Pilots with and without children were most likely to separate from training and operational installations, and most likely to be retained at foreign and unique mission installations. Pilots with different family situations also demonstrated different retention behavior at a subset of installations. Pilots without children were considerably more likely to separate from Columbus, Kadena, and Creech AFBs than their contemporaries with children. Pilots without children were considerably more likely to be retained at the Pentagon compared to those with children.

**Table 5.5 Base ALR Values for Pilots With and Without Children**

<table>
<thead>
<tr>
<th>Training Base</th>
<th>NC</th>
<th>C</th>
<th>Oper. Base</th>
<th>NC</th>
<th>C</th>
<th>For. Base</th>
<th>NC</th>
<th>C</th>
<th>UM Base</th>
<th>NC</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyndall</td>
<td>-5.1</td>
<td>-7.9</td>
<td>Hill</td>
<td>-4.2</td>
<td>-6.6</td>
<td>Spangd.</td>
<td>-3.4</td>
<td>-1.3</td>
<td>Pentagon</td>
<td>6.6</td>
<td>0.9</td>
</tr>
<tr>
<td>Luke</td>
<td>-4.9</td>
<td>-7.1</td>
<td>Shaw</td>
<td>-1.2</td>
<td>-4.6</td>
<td>Laken.</td>
<td>3.9</td>
<td>2.1</td>
<td>Edwards</td>
<td>8.1</td>
<td>6.6</td>
</tr>
<tr>
<td>Eglin</td>
<td>-2.6</td>
<td>-6.4</td>
<td>Holloman</td>
<td>-0.6</td>
<td>-4.3</td>
<td>Kunsan</td>
<td>3.9</td>
<td>2.1</td>
<td>Creech</td>
<td>-1.6</td>
<td>7.3</td>
</tr>
<tr>
<td>Randolph</td>
<td>-9.3</td>
<td>-5.3</td>
<td>Langley</td>
<td>-1.8</td>
<td>-2.0</td>
<td>Aviano</td>
<td>7.9</td>
<td>4.9</td>
<td>Maxwell</td>
<td>12.1</td>
<td>8.1</td>
</tr>
<tr>
<td>Columbus</td>
<td>-12.5</td>
<td>-4.9</td>
<td>Mtn Home</td>
<td>-0.4</td>
<td>-1.4</td>
<td>Kadena</td>
<td>-0.1</td>
<td>5.3</td>
<td>Kadena</td>
<td>-0.1</td>
<td>5.3</td>
</tr>
<tr>
<td>Nellis</td>
<td>-7.8</td>
<td>-4.8</td>
<td>Elmendorf</td>
<td>-0.9</td>
<td>-1.2</td>
<td>Osan</td>
<td>6.3</td>
<td>6.3</td>
<td>Osan</td>
<td>6.3</td>
<td>6.3</td>
</tr>
<tr>
<td>DM</td>
<td>-3.9</td>
<td>-2.1</td>
<td>Moody</td>
<td>-0.9</td>
<td>-0.1</td>
<td>Misawa</td>
<td>11.7</td>
<td>6.6</td>
<td>Misawa</td>
<td>11.7</td>
<td>6.6</td>
</tr>
<tr>
<td>Sheppard</td>
<td>-3.4</td>
<td>-1.3</td>
<td>Eielson</td>
<td>1.5</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Vance</td>
<td>-5.1</td>
<td>-0.7</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seymour-J.</td>
<td>-0.9</td>
<td>0.2</td>
<td></td>
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<td></td>
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<tr>
<td>Laughlin</td>
<td>0.6</td>
<td>0.6</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Average</td>
<td>-4.9</td>
<td>-4.2</td>
<td>-1.3</td>
<td>-2.6</td>
<td>4.9</td>
<td>5.4</td>
<td>7.1</td>
<td>5.5</td>
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</tbody>
</table>

Note: Installations where the difference in ALR values for mid-career and senior aviators is greater than 5% are

56
Table 5.6 offers further context about the retention behavior at each installation. It suggests where retention policies targeting pilots with/without children would have the greatest effects. Just like in the last section, installations with more extreme ALR values and many pilots making retention decisions will be best positioned to see meaningful change.

### Table 5.6 Additional Pilots With/Without Children to be Retained Under Average Retention Rates

<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyndall</td>
<td>2.2</td>
<td>7.4</td>
<td>Hill</td>
<td>1.7</td>
<td>4.4</td>
<td>Spangd.</td>
<td>1.6</td>
<td>1.5</td>
<td>Pentagon</td>
<td>-2.0</td>
<td>-0.6</td>
</tr>
<tr>
<td>Luke</td>
<td>5.3</td>
<td>12.8</td>
<td>Shaw</td>
<td>0.7</td>
<td>3.3</td>
<td>Laken.</td>
<td>-2.0</td>
<td>-0.3</td>
<td>Edwards</td>
<td>-2.0</td>
<td>-4.7</td>
</tr>
<tr>
<td>Eglin</td>
<td>1.3</td>
<td>7.6</td>
<td>Holloman</td>
<td>0.2</td>
<td>3.3</td>
<td>Kunsan</td>
<td>-2.0</td>
<td>-0.3</td>
<td>Creeech</td>
<td>0.3</td>
<td>-3.1</td>
</tr>
<tr>
<td>Randolph</td>
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<td>5.9</td>
<td>Langley</td>
<td>1.1</td>
<td>2.5</td>
<td>Aviano</td>
<td>-2.6</td>
<td>-1.7</td>
<td>Maxwell</td>
<td>-3.5</td>
<td>-6.0</td>
</tr>
<tr>
<td>Columbus</td>
<td>3.4</td>
<td>2.8</td>
<td>Mtn Home</td>
<td>0.2</td>
<td>0.8</td>
<td>Kadena</td>
<td>0.0</td>
<td>-2.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nellis</td>
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<td>9.3</td>
<td>Elmendorf</td>
<td>0.3</td>
<td>0.8</td>
<td>Osan</td>
<td>-5.2</td>
<td>-4.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>2.6</td>
<td>2.5</td>
<td>Moody</td>
<td>0.3</td>
<td>0.0</td>
<td>Misawa</td>
<td>-3.2</td>
<td>-1.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheppard</td>
<td>1.6</td>
<td>1.5</td>
<td>Eielson</td>
<td>-0.3</td>
<td>-0.6</td>
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<td></td>
</tr>
<tr>
<td>Vance</td>
<td>0.5</td>
<td>0.3</td>
<td></td>
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<tr>
<td>Seymour-J.</td>
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<td>-0.3</td>
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<td></td>
</tr>
<tr>
<td>Laughlin</td>
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<td></td>
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</tr>
<tr>
<td>Average</td>
<td>2.8</td>
<td>5.0</td>
<td>0.5</td>
<td>1.6</td>
<td>-1.9</td>
<td>-1.4</td>
<td>-1.8</td>
<td>-3.6</td>
<td></td>
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</tr>
</tbody>
</table>

Source: Original Analysis, 2020

### Demonstrating Pilots’ Revealed Basing Preferences

Understanding pilots’ basing preferences can improve the Air Force’s ability to connect pilots with tailored, retention improving assignments. This section demonstrates one way that the Air Force could learn more about what its pilots value. Comparing installation ALR values to the communities that surround each installation offers insight into the relationship between basing policy and pilot retention. The Air Force’s Supporting Military Families initiative highlights opportunities for spousal employment and the quality of local schools as two community characteristics that contribute to pilots QoL. In line with this initiative, this section compares installations’ ALR values to three community descriptors representing communities’ ability to support spousal employment and child development: population, population growth rate, and the quality of local schools. Understanding how the communities surrounding military installations...
affect pilot retention highlights another avenue through which the Air Force can increase pilot QoL/QoS, and ultimately retention.24

Typology

Before investigating how the three community descriptors studied in this dissertation affect pilot retention, it is worthwhile to understand how they relate with one another. This section develops a typology for domestic installations based on the civilian communities that surround them. Installations will be categorized as low/high population, low/high population growth, and low/medium/high quality school communities based on natural break points in the distribution of each characteristic. Understanding how community’s population, population growth, and school quality relate to each other will improve Air Force policymakers’ ability to interpret ALR values for installations in all types of communities.

The population and population growth rates for each installation are drawn from the U.S. Census Bureau’s 2019 estimates for the Micro/Metro Statistical Areas (MSAs) where the installations are located (U.S. Census Bureau, 2020). The quality of local schools is measured using GreatSchools Summary Ratings for the twenty highest rated schools within thirty miles of installations’ community centers. GreatSchools is an independent nonprofit organization committed to helping “all parents get a great education for their children and for communities to ensure that all students receive a quality education.” Their Summary Rankings incorporate schools’ test scores, student progress, college readiness, and equity into a comprehensive measure of school quality on a scale measured 1-10 (GreatSchools, 2020). The aggregated figure used in this analysis represents the best schools available to pilots stationed at each installation.

Figure 5.2 plots the log of community’s populations against their population growth rate since 2010. It also illustrates the sorting of installations into four categories of communities surrounding the base: high population high growth, high population low growth, low population high growth, low population low growth. High population installations are located in MSAs with populations of over 225,000. High growth installations are located in MSAs where the population has increased by more than 9% since 2010. Figure 5.2 demonstrates that there is a positive relationship between the log of community’s populations and population growth rates. These two community descriptors have a correlation coefficient of 0.71. Larger communities are more likely to be growing more quickly than smaller communities.

24 Appendix A explores other explanations for varying retention outcomes across the basing posture. Appendix A compares installation descriptors like experience distribution, deployments, and time on station against ALR values to identify other common threads among low/high ALR installations.
Figure 5.3 plots the quality of local schools against the population growth rate of communities surrounding military installations. It incorporates the same sorting mechanism for installations based on population growth rates and introduces a similar classification scheme for school quality. Installations surrounded by schools with an aggregated GreatSchools Summary Ranking of less than 5.6 are classified as having low quality schools. Installations surrounded by schools with aggregated Great Schools Summary Ranking of less than 8.7 are classified as having medium quality schools, and those above 8.7 as having high quality schools. The Figure depicts a positive relationship between population growth and the quality of local schools, confirmed by a correlation coefficient of 0.70. Faster growing communities tend to have higher quality schools.
Figure 5.3 School Quality vs Population Growth Rate

Figure 5.4 plots school quality against the log of community’s populations. It demonstrates the same classification scheme shown in the two previous figures. It also illustrates a positive relationship between community population and the quality of local schools. These two descriptors have a correlation coefficient of 0.54. Larger communities tend to have higher quality schools.

Source: U.S. Census Bureau, 2020, GreatSchools, 2020
Comparing Local Communities to ALR Values

This section compares the three community descriptors studied in this dissertation to installation ALR values. These comparisons are initially made independently, then two descriptors at a time, and lastly simultaneously using all three. Figure 5.5 plots installation ALR values against the populations of the surrounding communities, with the delineation between low/high population installations marked by a dashed grey line. When analyzed independently, there is not a significant relationship between retention outcomes and the population of the surrounding community. The log of community’s populations and ALR values boast a correlation coefficient of only 0.04. Pilots making retention decisions at installations located in large communities are just as likely to separate as pilots stationed in smaller communities.
Figure 5.5 Installation ALR Values vs Community Population

Figure 5.6 plots installations ALR values against the population growth rates of the surrounding communities, with the delineation between low/high population growth installations marked by a dashed grey line. It illustrates a slight negative correlation between retention and population growth rates, supported by a correlation coefficient of -0.26. Pilots are slightly more likely to separate from installations located near faster growing communities than those growing at a slower rate or shrinking.
Figure 5.6 Installation ALR Values vs Community Population Growth

Figure 5.7 plots installations’ ALR values against the quality of local schools in the surrounding community, with the delineation between low/medium/high school quality installations marked by a dashed grey line. Retention outcomes are weakly negatively correlated with the quality of local schools, supported by a correlation coefficient of -0.21. Pilots with children are slightly more likely to separate from active duty while stationed at installations near high quality schools than pilots making similar retention decisions in communities with lower quality schools.

Source: U.S. Census Bureau, 2020
Table 5.7 investigates the relationships between pairs of community descriptors and installations’ ALR values. Pairwise analysis provides further evidence of a weak negative relationship between population growth rate and retention. Across each classification of population and school quality, installations with high growth rates experienced lower ALR values than installations with low growth rates. Table 5.7 also demonstrates a weak negative relationship between school quality and ALR values. Installations with low population growth rates and low quality schools provide an interesting exception. This discrepancy is largely fueled by Columbus AFB, which received the lowest ALR value of -7.6%, but is surrounded by a community experiencing a negative population growth rate since 2010, and schools averaging a GreatSchools Summary Ranking of only 4.6.
Table 5.7 Comparing Community Characteristics to ALR Values

<table>
<thead>
<tr>
<th>Population</th>
<th>School Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Pop. Growth Low</td>
<td>2.1</td>
</tr>
<tr>
<td>High</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Original Analysis, 2020

Table 5.8 explores the relationship between three-way clusters of community descriptors and installations’ ALR values. The two tables list the average ALR values for installations in each of the 12 combinations of population, population growth, and school quality classifications. The left half of Table 5.8 depicts the average ALR values for installations located in low population communities. The right half conveys average ALR values for installations in high population communities. Cells marked (−) indicate that there are not any installations that fit the combination of community descriptors. For example, there are zero installations classified as low population and high population growth, therefore each cell representing this combination of installations is marked (−).

Binning installations in this manner does not suggest any new conclusions about the relationship between these three community descriptors and pilot retention. Table 5.8 provides additional evidence for a weak negative relationship between population growth and retention, as well as school quality and retention. Installations with high populations, low growth rates, and medium quality schools have an average ALR value of 8.1%. Maxwell and Edwards AFBs are the only two installations in this category, and as unique mission installations are responsible for this irregular value.

Table 5.8 Comparing Community Characteristics to ALR Values

<table>
<thead>
<tr>
<th>Low Pop.</th>
<th>School Quality</th>
<th>High Pop.</th>
<th>School Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Med.</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Pop. Growth</td>
<td>-2.6</td>
<td>-2.0</td>
<td>-</td>
</tr>
<tr>
<td>High</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: Maxwell and Edwards AFBs are the only two installations categorized as high population, low population growth, and medium school quality. They are responsible for the abnormally high 8.1% average ALR value for this category of installations. Source: Original Analysis, 2020

Conclusions

Fighter pilots making retention decisions are more likely to be retained at some installations and to separate at others after accounting for a host of relevant control variables. From 2000 to
2019, fighter pilots were considerably more likely to separate from training installations and make retention decisions that extend their active duty service at foreign and special mission installations. This variation in retention outcomes across the USAF’s basing posture presents a unique opportunity for the Air Force to improve retention by offering assignments in line with pilots’ individual preferences.

The second part of this section demonstrates that pilot preferences are dynamic, and in some cases change as pilots professional and familial status change. Some installations experience significantly different retention outcomes with mid-career compared to senior pilots, in addition to pilots with children and pilots without. These discrepancies illustrate another example of how the Air Force could create tailored assignments to increase retention.

Lastly, the VAM used in this dissertation can be used to highlight pilots’ revealed basing preferences. The final section of this chapter compared installations’ ALR values to community descriptors identified in the Air Force’s Supporting Military Families initiative as important contributors to pilots QoL. Opportunities for spousal employment and the quality of local schools, as measured by population, population growth and GreatSchools Summary Rankings, are not strongly related to pilot retention. Interestingly, this analysis suggests a weak negative relationship between both population growth and the quality of local schools, and pilot retention. This suggests that the Air Force’s goals of increasing pilot retention and increasing pilot QoL may at times be competing objectives. Future analysis should conduct a more comprehensive analysis of how military communities affect pilot retention to better isolate individual effects.
Chapter five investigated relationships between pilot retention, the USAF basing posture, and the communities surrounding military installations. The variation in retention outcomes observed across the USAF’s basing posture demonstrates installations’ relevance to pilots’ decision-making process, and a subsequent opportunity for the Air Force to improve its retention policy. Providing pilots with tailored assignments in line with their basing preferences could substantially improve pilots’ retention outcomes. On a micro level, these policy changes would strongly resemble the goals of the Talent Marketplace assignment platform that the Air Force is currently transitioning into. Giving pilots more agency in the assignment process will allow them to inject their previously unknown preferences into the system, increasing retention rates. These adjustments to Air Force policy could take place without any changes to the USAF basing posture.

However, including these considerations in the Air Force’s basing decision calculus could move the Air Force towards a basing posture that intrinsically supports pilot retention. Throughout the Air Force’s history, major base realignments are few and far between. Doing so requires large sums of political willpower and therefore cannot be expected with any regularity. Recently, the only large base realignments have occurred under the BRAC legislation. The Air Force has little influence as to when BRACs are conducted because they must be initiated by Congress. Congress has not issued a BRAC since 2005, leaving the armed services operating substantial amounts of unneeded infrastructure (Principi, 2015).

The F-35 is advertised as the replacement for the Air Force’s aging fleet of F-16 and A-10 aircraft. With the Air Force planning to buy hundreds over the coming years the service will need to stand up new squadrons to operate the new F-35 aircraft (Insinna, 2019). Doing so will require the employment of the Strategic Basic Process to determine the installations that will host the new units. These decisions affect the Air Force’s ability to complete its mission as well as the economic vitality of communities where new F-35 squadrons will be placed.

The onboarding of the F-35 gives the Air Force the unique ability to manipulate its basing posture outside of a Congressionally mandated BRAC. Given the lingering pilot shortages which limit the Air Force’s ability to complete its mission, the Air Force should take advantage of this opportunity and consider pilot retention preferences when establishing new F-35 squadrons. This chapter will investigate how incorporating the pilot preferences analyzed in chapter five into F-35 basing decisions could impact future pilot retention.
Studying Retention Effects at Installations Already Hosting 5th Generation Aircraft

All installations currently hosting operational F-22 or F-35 squadrons previously hosted 4th generation fighter aircraft. Langley, Elmendorf and Tyndall AFBs currently operate F-22 squadrons, but previously hosted F-15 squadrons. Hill, Eglin, and Luke AFBs operate active duty F-35 squadrons, but previously hosted F-16 squadrons.\textsuperscript{25} This section will investigate how transitioning from 4th to 5th generation aircraft affected pilot retention at each base, and how that experience could better inform decision makers expectations for the retention consequences of activating future F-35 squadrons.

To this point, the VAM estimates discussed have used a twenty-year time horizon to measure installations’ effects on pilot retention. In this chapter, VAM estimates will be calculated in three-year blocks in order to highlight how changes at individual installations contributed to pilot retention trends. The concept of ALR values remains the same, with each value designating how much more likely a pilot was to separate when making a retention decision while stationed at a given installation, relative to an average installation. The only difference being that the analysis in Chapter Five used twenty years-worth of data to calculate an aggregated twenty-year ALR value. In this chapter, the VAM compares retention outcomes at each base across seven, three-year time windows, generating seven ALR estimates for each installation.

Figure 6.1 plots current the ALR values at installations currently operating fifth generation fighter squadrons. The x axis describes the number of years before/after the installations transition to fifth generation aircraft. Figure 6.1 plots up to ten years of ALR values before/after a transition, depending on data availability. For example, Hill AFB transitioned from F-16s to F-35s in 2016. Figure 6.1 shows ten years of data before the transition, but only three years of data after the transition because this dissertation only uses data collected through 2019. Transitioning from 4th generation aircraft to 5th generation aircraft does not have uniform effects on retention outcomes. At some installations, this transition led to an increase in pilot retention. At others, a decrease in retention. And at the remainder, the transition did not change retention outcomes.

\textsuperscript{25} Eielson AFB is in the process of standing up an F-35 squadron.
These results suggest that the Air Force should not expect any systematic changes in retention behavior simply by converting an installation to fifth generation aircraft. This also suggests that installations’ pre-transition contribution to pilot retention is the best predictor of retention behavior post-transition. The following section will analyze current A-10, F-15E, and F-16 installations that are prime candidates to become F-35 bases in increased depth.

Evaluating the Retention Behavior at Potential Future F-35 Installations

As evidenced by the locations of existing F-35 squadrons, the Air Force is prone to stationing new squadrons in the same locations as the units they are replacing. These installations already have much of the infrastructure needed to host fifth generation fighter squadrons, offering the

26 Although there was a significant change in retention behavior at Elmendorf following its transition to F-22s, this drop coincides with a fatal crash, numerous unexplained physiological flight events, and a controversial response by AF leadership that dramatically affected the fighter pilots stationed here. This situation is discussed in greater detail in Appendix B.
Air Force substantial savings in military construction. Moreover, the Air Force has been consolidating its flying capabilities, rather than expanding them since the end of the Cold War. These trends suggest that current domestic installations hosting fifth generation aircraft are prime candidates to become future F-35 installations.\textsuperscript{27} With this in mind, this section will examine the retention behavior of current A-10, F-15E, and F-16 installations to better understand what might happen to that installation’s retention behavior should the base be chosen for a future upgrade to 5\textsuperscript{th} generation aircraft.

To understand how retention behavior has varied over time at USAF installations this dissertation measured each installation’s single-, three-, five- and twenty-year ALR values from 2000-2019. As was described in the previous section, each measure describes the retention outcomes at each base during a certain time period, compared to other installations. Estimates with smaller time horizons, such as single-year estimates, offer a higher fidelity description of retention behavior at each base, but at the cost of increased noise. Particularly at smaller installations, the limited number of retention decisions made each year at these bases limits the utility of single year estimates. For this reason, this section focuses on five-year ALR estimates. To find a complete analysis of single-, three-, five- and twenty-year ALR values at each prospective F-35 installation please reference appendix B.

Figure 6.2 plots the five-year ALR values for Davis-Monthan, Holloman, Moody, Mountain Home, Shaw and Seymour-Johnson AFBs. Each of these installations currently host A-10, F-15E, or F-16 aircraft and therefore are prime candidates to host F-35 squadrons in the future. From 2000-2019, these installations experienced varying retention behavior. When aggregated using the twenty-year ALR values, these installations ranged from -3.3\% at Holloman AFB to 0.1\% at Seymour-Johnson AFB. But five-year ALR estimates tell a more detailed story.

For example, ALR values at Holloman AFB have been decreasing steadily since 2000. From 2000-2004 pilots making retention decisions at Holloman AFB were 5.0\% more likely to be retained than pilots making equivalent decisions at an average base. But from 2015-2019, pilots at Holloman were 10.5\% more likely to separate than pilots stationed at an average installation. Conversely, Moody AFB has experienced a dramatic increase in ALR values since 2010. From 2010-2014, Moody received an ALR value of -2.4\%, but from 2015-2019 that figure increased to 6.0\%. The ALR values at the other 4 bases generally oscillated around their twenty-year ALR values.

Figure 6.2 demonstrates that prospective F-35 installations do demonstrate different retention outcomes, particularly in the last five years. Pilots making retention decisions while stationed at Moody AFB were considerably more likely to be retained than pilots making equivalent decisions at Holloman and Shaw AFBs. If the Air Force were to station F-35 pilots at Moody

\textsuperscript{27} The USAF does not currently have any 5\textsuperscript{th} generation aircraft permanently stationed overseas. For this reason only domestic A-10, F-15E, and F-16 bases will be analyzed.
AFB in the future, it could expect them to be influenced by the same forces that have made pilots more likely to be retained there over the last five years.

The Air Force can capitalize on this variation in retention outcomes to move towards a basing posture that passively supports pilot retention. The Air Force could add pilot retention considerations to the Air Force Strategic Basing Process’ evaluation criteria to increase the likelihood that installations supporting increased pilot retention receive F-35 squadrons. In so doing, the Air Force could develop a passive, pilot-retention increasing policy that addresses the enterprise-wide pilot shortage.

**Figure 6.2 ALR Values Over Time at Prospective F-35 Installations**

![Figure 6.2 ALR Values Over Time at Prospective F-35 Installations](Image)

Source: Original Analysis, 2020

**Conclusions**

Each installation currently hosting fifth generation fighter squadrons previously hosted fourth generation fighter squadrons. Unfortunately for the Air Force, converting an installation from hosting fourth to fifth generation fighter aircraft does not have uniform effects on retention at that installation. Prospective future F-35 installations have also experienced varying retention
behavior over the last twenty years, and especially the last five years. Pilots making retention
decisions while stationed at Moody AFB were considerably more likely to be retained than pilots
making equivalent retention decisions at Holloman and Shaw AFBs.
7. Conclusion, Recommendations, and Opportunities for Future Research

This dissertation comes at a unique time for the pilot retention conversation in the Air Force. COVID has temporarily alleviated one of the biggest stressors on pilot retention: civilian airline hiring. But these conditions will not last forever, and the Air Force must once again be forced to retain pilots when the airlines are hiring. To do so they need novel solutions that go beyond the bonuses that have been offered to pilots in the past. Incorporating pilot retention considerations into the Air Force’s basing decision-making process is a currently underappreciated mitigation strategy.

This dissertation employs a novel methodology to estimate installations effects on pilot retention outcomes. Its first research question employs a value-added model most commonly found in education and healthcare literatures to analyze two decades of fighter pilot retention decisions, finding meaningful variation in retention outcomes across the USAF basing posture. These variations in retention likelihoods cluster based on installations primary mission, with pilots more likely to separate from training and operational assignments, and more likely to be retained at foreign and unique mission installations. Examining the retention behavior of pilots of varying experience levels and family situations confirms these trends while highlighting some exceptions. These variations demonstrate unique opportunities for the Air Force to capitalize on individual preferences, and offer pilots tailored, retention improving assignments.

The second research question compares pilots’ varying retention outcomes to the communities that surround each installation, specifically the characteristics outlined in the Air Force’s Supporting Military Families initiative. This policy highlights spousal employment opportunity and the quality of local schools as two important drivers of pilot quality of life. Across the thirty installations included in this study, these community descriptors are not strong predictors of retention outcomes. A noteworthy point of clarity comes among high population, high population growth and high school quality bases, all of which have low ALR values, with the exception of the pentagon, which is unique for its own reasons. The lack of a strong relationship between retention outcomes and community descriptors calls into question the Air Force’s understanding of how QoL influences pilot retention. This dissertation suggests that there is not a strong relationship between the two, and in fact may be an inverse relationship. This would make increasing pilot retention and pilot QoL competing interests, and would seriously call into question the proposed policy solutions like the Supporting Military Families initiative’s ability to increase pilot retention by increasing QoL.

The third research question demonstrates how this methodology can be used to better inform future F-35 basing decisions. Although this dissertation does not find consistent retention consequences when installations transition from 4th generation aircraft to 5th generation aircraft,
it does highlight variation in retention outcomes among prospective F-35 bases. ALR values from the last five years suggest that pilots making retention decisions at Moody AFB are more likely to be retained than pilots making retention decisions at Holloman. Investing in bases like Moody could increase retention trends across the force.

Policy Recommendations and Additional Research

This section will introduce various policy recommendations the Air Force could implement to improve pilot retention based on the findings of this dissertation. It will also discuss future opportunities for additional research.

Policy Recommendations

Pilots’ unique installation preferences provide opportunities for the Air Force to offer retention improving, tailored installation assignments. Historically, the Air Force has lacked the flexibility in its assignment process to offer pilots assignments that align with their individual priorities and tastes. This results in the premature separation of many pilots who may have continued their active duty careers had they been offered a different assignment. However, new policy initiatives like the Talent Marketplace assignment platform are vastly improving the Air Force’s ability to connect officers with assignments that align with their individual preferences and priorities. Talent Marketplace and policies like it that collect information about pilots unique professional and personal preferences should be continued, expanded, and their data made available for analysis. Potential expansions could include data collection efforts that capture pilots’ desired operational tempo, assignment length, and deployment/exercise schedule.

This dissertation did not find a compelling relationship between pilot retention and pilots’ assignment to installations with high opportunities for spousal employment and high quality schools. In order to fully appreciate the retention consequences of the Supporting Military Families initiative and other policies aimed at increasing pilot QoL, the Air Force should commit to improving its understanding of the relationship between the communities surrounding military installations, pilot QoL, and pilot retention.

After more information has been collected and pilot preferences identified, the Air Force should implement these preferences into the Strategic Basing Process in order to create a basing posture that intrinsically supports increased pilot retention. Such a policy could leverage a value-added model very similar to the one described in this dissertation to generate ALR values for installations being considered in basing actions. The ALR values could then be implemented into the Strategic Basing Process as an additional criterion that seeks to include an enterprise wide solution to pilot shortages.
Opportunities for Future Analysis

This dissertation’s greatest shortcoming is that it does not account for individual pilot preferences when estimating installation-effects. Failing to do so might understate ALR values due to the canceling out of installation-effects from pilots with positive/negative effects from each installation. Data collected from the Talent Marketplace will allow analysts to account for how individuals’ assignments compare to their expressed assignment preferences, and therefore more accurately model the effects of a single assignment on a single individual. Equipped with this information, future researchers could apply an improved value-added model to the same data studied in this dissertation, and generate less-biased estimates of installation ALR values.

An improved version of this dissertation would likely include some method of accounting for how pilots who received their first choice of assignment behaved compared to those who received their second, third, fourth… etc. These improved ALR estimates could be used to support a more complete investigation of pilots’ revealed preferences. Such an investigation would move beyond the QoL measures outlined in the Air Forces Supporting Military Families initiative and incorporate other QoL measures from the communities surrounding military installations. These might include property values, crime rates, higher education opportunities, entertainment opportunities…etc. With a more complete understanding of retention relevant QoL drivers, the Air Force could improve its ability to predict how basing actions under consideration would likely affect pilot retention.

Lastly the Air Force could substantially benefit from understanding how pilots value proposed retention methods in context with one another. Evaluating the perceived value of different retention tools could equip the Air Force to make trade-offs between inefficient bonus payouts and more efficient tailored retention incentives. Choice experiments could be leveraged to yield these types of insights. This methodology could present pilots with a series of survey questions asking which retention incentive would make them more likely to continue their active duty careers. Choices might include trade-offs between financial bonus, preferred assignments, increasing assignment length, the opportunity to cross-train…etc. A properly constructed protocol will allow the Air Force to estimate the value of each retention incentive in a previously impossible way.
Appendix A. Comparing High- and Low- ALR Installations

This appendix will compare high-and low ALR installations in order to understand the variation in retention behavior across USAF installation. Installations are compared using covariates included in the model.

Experience Levels

The pilots making retention decisions at high-ALR installations were not systemically any more or less experienced than pilots at low-ALR installations. Table A.1 lists the distribution of retention decisions made by pilots of each rank at the seven highest and lowest ALR installations. At the average installation 26% of retention decisions were made by Captains, 44% by Majors, and 28% by LtCols.

<table>
<thead>
<tr>
<th>Installation</th>
<th>Capt</th>
<th>Maj</th>
<th>LtCol</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW Average</td>
<td>26.67</td>
<td>44.91</td>
<td>28.42</td>
</tr>
<tr>
<td>Columbus</td>
<td>23.28</td>
<td>43.88</td>
<td>32.84</td>
</tr>
<tr>
<td>Tyndall</td>
<td>31.67</td>
<td>42.96</td>
<td>25.37</td>
</tr>
<tr>
<td>Randolph</td>
<td>8.9</td>
<td>47.28</td>
<td>43.82</td>
</tr>
<tr>
<td>Luke</td>
<td>29</td>
<td>49.87</td>
<td>21.14</td>
</tr>
<tr>
<td>Hill</td>
<td>35.95</td>
<td>37.38</td>
<td>26.67</td>
</tr>
<tr>
<td>Nellis</td>
<td>13.05</td>
<td>64.89</td>
<td>22.07</td>
</tr>
<tr>
<td>Eglin</td>
<td>20.21</td>
<td>46.76</td>
<td>33.04</td>
</tr>
</tbody>
</table>

Table A.1 Rank Distribution at Low- and High-ALR Installations

<table>
<thead>
<tr>
<th>Installation</th>
<th>Capt</th>
<th>Maj</th>
<th>LtCol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misawa</td>
<td>51.35</td>
<td>31.08</td>
<td>17.57</td>
</tr>
<tr>
<td>Maxwell</td>
<td>0</td>
<td>68.11</td>
<td>31.89</td>
</tr>
<tr>
<td>Edwards</td>
<td>15.14</td>
<td>55.61</td>
<td>29.24</td>
</tr>
<tr>
<td>Osan</td>
<td>31.89</td>
<td>50.58</td>
<td>17.53</td>
</tr>
<tr>
<td>Aviano</td>
<td>42.8</td>
<td>38.01</td>
<td>19.19</td>
</tr>
<tr>
<td>Spangdahlem</td>
<td>46.64</td>
<td>35.45</td>
<td>17.91</td>
</tr>
<tr>
<td>Creech</td>
<td>24.17</td>
<td>52.08</td>
<td>23.75</td>
</tr>
</tbody>
</table>

Note: The bold text indicates the Force Wide average distribution of experience.

Source: AFPC, 2019

Contrary to the notion that an installation’s experience mix affects its ALR value, it appears that the mission conducted at each installation determines the ratios of experience levels employed at that installation. Installations hosting combat coded squadrons host more junior pilots, meanwhile installations hosting training, test or administrative missions employ more senior pilots.

Exercise and Contingency Operations

The pilots making retention decisions at high-ALR installations spent slightly more time supporting exercise operations than pilots at low-ALR installations. Across the seven highest
ALR installations pilots averaged spending 23.50 days per ADSC supporting exercise operations, just 3% less than the force-wide average. Conversely pilots making retention decisions at the seven lowest ALR installations averaged spending 16.66 days per ADSC supporting exercise operations. Table A.2 lists pilots’ average days supporting contingency operations per ADSC at each installation.

Table A.2 Average Days Supporting Exercise Ops per ADSC at Low- and High-ALR Installations

<table>
<thead>
<tr>
<th>Low-ALR Installation</th>
<th>Av. Days</th>
<th>High-ALR Installation</th>
<th>Av. Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW Average</td>
<td>20.44</td>
<td>Misawa</td>
<td>43.92</td>
</tr>
<tr>
<td>Columbus</td>
<td>11.53</td>
<td>Maxwell</td>
<td>5.76</td>
</tr>
<tr>
<td>Tyndall</td>
<td>16.5</td>
<td>Edwards</td>
<td>8.79</td>
</tr>
<tr>
<td>Randolph</td>
<td>6.975</td>
<td>Osan</td>
<td>33.19</td>
</tr>
<tr>
<td>Luke</td>
<td>16.44</td>
<td>Aviano</td>
<td>32.69</td>
</tr>
<tr>
<td>Hill</td>
<td>32.95</td>
<td>Spangdahlem</td>
<td>26.73</td>
</tr>
<tr>
<td>Nellis</td>
<td>19.03</td>
<td>Creech</td>
<td>13.44</td>
</tr>
<tr>
<td>Eglin</td>
<td>14.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>16.66</td>
<td>Avg</td>
<td>23.50</td>
</tr>
</tbody>
</table>

Note: Averages are weighted by the number of retention decisions made at each base.

Source: AFPC, 2019

Pilots at both high- and low-ALR installations spent less time per ADSC supporting contingency operations than pilots at an average installations. Pilots spent an average of 58.80 days deployed at high-ALR installations and 62.83 days deployed at low-ALR installations, compared to a force-wide average of 69.36 days per ADSC.

Table A.3 Average Days Supporting Contingency Ops per ADSC at Low- and High-ALR Installations

<table>
<thead>
<tr>
<th>Low-ALR Installation</th>
<th>Av. Days</th>
<th>High-ALR Installation</th>
<th>Av. Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW Average</td>
<td>69.36</td>
<td>Misawa</td>
<td>95.58</td>
</tr>
<tr>
<td>Columbus</td>
<td>63.13</td>
<td>Maxwell</td>
<td>33.88</td>
</tr>
<tr>
<td>Tyndall</td>
<td>50.49</td>
<td>Edwards</td>
<td>40.03</td>
</tr>
<tr>
<td>Randolph</td>
<td>49.33</td>
<td>Osan</td>
<td>47.95</td>
</tr>
<tr>
<td>Luke</td>
<td>53.86</td>
<td>Aviano</td>
<td>83.2</td>
</tr>
<tr>
<td>Hill</td>
<td>109.16</td>
<td>Spangdahlem</td>
<td>80.45</td>
</tr>
<tr>
<td>Nellis</td>
<td>74.12</td>
<td>Creech</td>
<td>73.48</td>
</tr>
<tr>
<td>Eglin</td>
<td>52.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>62.83</td>
<td>Avg</td>
<td>58.80</td>
</tr>
</tbody>
</table>

Note: Averages are weighted by the number of retention decisions made at each base.

Source: AFPC, 2019

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As was the case with rank distribution, the mission conducted at each base continued to determine exercise and deployment rates. Pilots at training and unique mission bases participated in less exercise and contingency operations than pilots at operational installations.

Time On Station

Pilots at all low-ALR installations and the majority of high-ALR installations experienced similar TOS to their peers across the 30 bases included in this study. Osan AB and Maxwell AFB are noteworthy exceptions. Pilots assigned to Osan AB typically serve a one-year unaccompanied tour, making the average TOS over 250 days less than the force-wide average. Maxwell AFB hosts Air Command and Staff College, a one-year professional military education regimen for Majors. For this reason, pilots stationed to Maxwell AFB experience TOS more than a full year less than force-wide averages. Table A.4 lists the average TOS per ADSC for pilots at the seven highest and lowest ALR installations.

Table A.4 Average Time On Station per ADSC at Low- and High-ALR Installations

<table>
<thead>
<tr>
<th>Low-ALR Installation</th>
<th>Av. Days</th>
<th>High-ALR Installation</th>
<th>Av. Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>FW Average</td>
<td>616.28</td>
<td>Misawa</td>
<td>544.87</td>
</tr>
<tr>
<td>Columbus</td>
<td>747.16</td>
<td>Maxwell</td>
<td>238.10</td>
</tr>
<tr>
<td>Tyndall</td>
<td>610.92</td>
<td>Edwards</td>
<td>553.48</td>
</tr>
<tr>
<td>Randolph</td>
<td>736.96</td>
<td>Osan</td>
<td>337.61</td>
</tr>
<tr>
<td>Luke</td>
<td>675.15</td>
<td>Aviano</td>
<td>571.10</td>
</tr>
<tr>
<td>Hill</td>
<td>554.9</td>
<td>Spangdahlem</td>
<td>542.84</td>
</tr>
<tr>
<td>Nellis</td>
<td>656.90</td>
<td>Creech</td>
<td>708.09</td>
</tr>
<tr>
<td>Eglin</td>
<td>615.33</td>
<td>Avg</td>
<td>460.27</td>
</tr>
</tbody>
</table>

Note: Averages are weighted by the number of retention decisions made at each base.

Source: AFPC, 2019
Appendix B. Complete Analysis of Individual Bases

This appendix contains the analysis of retention behavior at each installation that has experienced a transition from 4th to 5th generation aircraft, as well as current A-10/F-16 installations that could become F-35 bases in the future.

Installations Hosting 5th Generation Fighter Aircraft

All installations currently hosting operational F-22 or F-35 squadrons previously hosted 4th generation fighter aircraft, and therefore completed a 4th to 5th generation transition to arrive in their present state. These bases include: Langley, Elmendorf and Tyndall AFBs, which operate active duty F-22 squadrons, and Hill, Eglin, and Luke AFBs which operate active duty F-35 squadrons.\(^{28}\) This section will contain mini-case studies on each base to investigate how the 4th to 5th generation transition affected pilot retention behavior, and how that experience could better inform decision makers expectations for the retention consequences of activating future F-35 squadrons.

Elmendorf AFB

Elmendorf AFB operates C-17, C-12, E-3, and F-22 squadrons near Anchorage, AK (USAF, 2020). It has an aggregate ALR value of -1.077%, indicating that pilots making retention decisions while stationed at Elmendorf are 1% less likely to be retained that pilots making an identical decision at an average base. Mid-career pilots senior pilots, pilots with children, and pilots without children all behaved very similarly, giving Elmendorf ALR values within 1% of its aggregate ALR value. Table B.1 lists Elmendorf’s ALR values for each subpopulation.

<table>
<thead>
<tr>
<th>Subpopulation</th>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elmendorf</td>
<td>-1.077</td>
<td>-1.353</td>
<td>-0.558</td>
<td>-1.180</td>
<td>-0.875</td>
</tr>
</tbody>
</table>

Source: Original Analysis, 2020

In 2019 Anchorage had a population of almost 400,000 people, which increased by 4.1% since 2010, and local schools with an average GreatSchools rating of 9.4 (U.S. Census Bureau, 2020).

\(^{28}\) Eielson AFB is in the process of standing up an F-35 squadron.
Elmendorf’s ALR score is in line with what we would expect given its community descriptors. The installation is located in an average sized community, growing at about the average rate, but with above average school. As we would expect, Elmendorf has slightly below average ALR values.

Figure B.1 plots Elmendorf’s single-, three-, five-, and twenty-year ALR values over time, as well as the number of retention decisions made each year. Prior to this appendix, each ALR value discussed has been a twenty-year ALR value, meaning that pilots’ retention decisions from 2000-2019 were used to estimate the additional likelihood of retention for pilots stationed at each base. Single-, three- and five-year ALR values calculate base-effects using the same VAM model, but across shorter time horizons. Analyzing Elmendorf’s single-, three- and five-year ALR values yields insights into how retention behavior at Elmendorf has changed from 2000-2019. With less decision points in each ALR estimate, single-year ALR estimates can be considerably noisier than five-, and especially 20-year estimates. This is especially true at installations where fewer retention decisions are made. These types of figures will be used to analyze each base in this appendix.

Elmendorf AFB transitioned from operating F-15C/D fighter aircraft to operating F-22 aircraft in 2010. In the same year, Capt. Jeffrey A. Haney was killed in a training accident, and F-22 pilots were reporting an abnormally high amount of “in-flight physiological events.” Pilots were experiencing oxygen deprivation symptoms mid-flight, and no one could find the cause, or evidence of a malfunction. In May 2011 the Air Force grounded all F-22s to conduct a safety investigation into the aircraft’s onboard oxygen-generating system (OBOGS). Five months later, the Air Force still had not found a cause or a cure, but lifted the stand-down after equipping pilots with risk mitigating equipment and procedures (Church, 2011).

Following the return to flight, the number of oxygen depletion related in-flight physiological events increased. Pilots reportedly felt that their leaders were minimizing their episodes because the safety investigation found nothing wrong with the OBOGS. In May 2012, F-22 pilots defiantly said they would no longer fly the aircraft in an interview for CBS News’s “60 Minutes” (Bumiller, 2012). These incidents likely affected pilot retention at Langley.’

From 2010 to 2013, Elmendorf’s ALR values dropped precipitously to well below average. From 2015-2019, Elmendorf’s ALR values returned to their 2000-2010 levels. Further analysis is needed to fully understand the relationship, but it appears that a combination of the F-15C/D to F-22 transition and the OBOGS crisis were responsible for a serious increase in pilots separating from the Air Force while stationed at Elmendorf AFB from 2011-2013.
Langley AFB

Langley AFB operates two F-22 squadrons, a T-38 adversary air squadron, and hosts the headquarters for Air Combat Command (USAF, 2020). Langley AFB is a component of Joint Base Langley-Eustis and is located outside Newport News, VA. Pilots making retention decisions from 2000-2019 gave Langley an ALR value of -2.061%, indicating that pilots are 2.1% more likely to separate from Langley than an average installation. Senior pilots were slightly more likely to separate from Langley, but pilots with/without children were equally likely to separate. Table B.2 lists Langley’s ALR values for each subpopulation of pilots.

Table B.2 ALR Values by Subpopulation at Langley AFB

<table>
<thead>
<tr>
<th></th>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Langley</td>
<td>-2.061</td>
<td>-0.804</td>
<td>-2.790</td>
<td>-1.983</td>
<td>-1.798</td>
</tr>
</tbody>
</table>

Source: Original Analysis, 2020
The Virginia Beach-Norfolk-Newport News community surrounding Langley AFB boasts a population of 1,768,901 that grew 3.2% since 2010 and local schools averaging a GreatSchools Rating of 9.25 (U.S. Census Bureau, 2020; GreatSchools, 2020). An above average size population, growing at a below average rate with above average quality schools is in line with an installation receiving slightly below average ALR values.

Figure B.2 plots Langley’s single-, three-, five- and twenty-year ALR values over time. Langley’s ALR values are relatively consistent over the twenty years included in this study. Even through the base’s transition from F-15C/D to F-22 aircraft there is relatively little change in ALR values. Langley’s five-year ALR value from 2005-2010 is about 5% lower than from 2010-2015. However, Langley’s ALR values return to 2000-2010 levels from 2015-2019. Also of note, Langley did not experience a similar exodus from 2011-2013 during the F-22 OBOGS crisis.

It is unclear what could be responsible for the stability of Langley’s ALR values. One possible explanation is that the presence of ACC headquarters increases the amount senior pilots making retention decisions at Langley. Officers serving in staff positions might be insulated from factors causing swings in retention outcomes at other installations.

![Figure B.2 ALR Values Over Time at Langley AFB](source: Original Analysis, 2020)
Tyndall AFB

Prior to Hurricane Michael, Tyndall AFB hosted an F-22 FTU training squadron, an operational F-22 squadron, and an adversary air T-38 squadron (USAF, 2020). Tyndall AFB is located outside Panama City, FL. Tyndall received the second lowest ALR value of any of the thirty bases included in this study. Tyndall’s ALR was particularly low among senior aviators. Senior aviators were 9.2% more likely to separate from Tyndall AFB compared to an average base, while mid-career aviators were only 2.4% more likely to separate from Tyndall than an average installation. Interestingly this trend persists along children/no children lines, but is less pronounced. Table B.3 lists ALR values for each subpopulation at Tyndall.

Table B.3 ALR Values by Subpopulation at Tyndall AFB

<table>
<thead>
<tr>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>No Children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>-7.924</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-5.138</td>
</tr>
</tbody>
</table>

The Panama City community that surrounds Tyndall AFB had a population of 174,705 in 2019, grew 3.5% from 2010 to 2019, and hosts schools averaging a GoodSchools Summary Rating of 7.35 (U.S. Census Bureau, 2020; GreatSchools, 2020). Tyndall’s ALR value is extraordinary given its surrounding community. Panama City is average sized compared to the other bases included in this study, growing beneath the average rate, and has slightly below average schools. Yet, it is the second lowest ALR base.

Figure B.3 plots Tyndall’s ALR values over time. In 2003, Tyndall began completing F-22 training. Its transition from the F-15C/D to the F-22 continued from 2006-2010 as the Air Force deactivated three F-15C/D squadrons based at Tyndall. In 2013, Tyndall gained a combat coded F-22 squadron. And in 2018, Hurricane Michael destroyed the installation, destroying numerous aircraft, and damaging every building on base (Achenback, Begos and Lamothe, 2018). Since then many of the base functions have been relocated to Langley AFB, but the future of the installation remains uncertain.

Over the course of these transitions Tyndall AFB’s ALR values have changed considerably. From 2000 to 2006, Tyndall’s ALR values trended upwards. Yet from 2006 to 2019, the base’s ALR values have declined steadily. Of note, as the original F-15C/D squadrons were deactivated the number of fighter pilots making retention decisions at Tyndall also decreased. It is unclear what could be responsible for this steady decline of ALR values.
Hill AFB

Hill AFB hosts the 388th Fighter Wing operating the F-35 and is located outside Ogden, UT. Hill was the lowest ALR installation not supporting a training mission. Hill has an aggregate ALR value of -5.793%, indicating that pilots are 5.8% more likely to separate from Hill than an average installation. Mid-career and senior aviators separated from Hill at similar rates, however pilots with children are slightly more likely to separate from Hill than pilots without. Table B.4 lists the ALR values for each subpopulation at Hill.

Table B.4 ALR Values by Subpopulation at Hill AFB

<table>
<thead>
<tr>
<th></th>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hill</td>
<td>-5.793</td>
<td>-6.264</td>
<td>-5.885</td>
<td>-6.592</td>
<td>-4.246</td>
</tr>
</tbody>
</table>

Source: Original Analysis, 2020
Hill is located in the Ogden-Clearfield Metro Statistical Area. The community was home to 683,864 people in 2019, a population that’s grown 14.5% since 2010 (U.S. Census Bureau, 2020). The highest ranked schools surrounding the base average a GreatSchools Summary Score of 7.6 (GreatSchools, 2020). The community surrounding Hill AFB is above average compared to other bases in population and growth rate, and average in school quality. These measures are in line with a low ALR score.

Figure B.4 plots the single-, three-, five- and twenty-year ALR values for Hill AFB over time. From 2000 to 2015 Hill AFB operated F-16 squadrons and maintained below-average ALR values. Referencing Hill’s 5-year ALR value specifically demonstrates a steady ALR ranging from -8.3% to -7.6% from 2000-2014. Beginning with the F-16 to F-35 transition and in the three years following, Hill’s ALR scores have increased substantially. Hill’s five-year ALR value from 2015 to 2019 increased to 1.7%, and its three-year ALR value to 6.4% from 2017-2019.

Again, this analysis does not imply a causal connection between the 4th to 5th generation transition and increasing ALR values. But, a sizable increase in Hill’s ALR values coincides with the installation’s transition from F-16 to F-35 aircraft. Further research is warranted to determine the causality of such a relationship.
Luke AFB

Luke AFB is a large fighter installation located near Phoenix, AZ. For years, Luke has hosted F-16 FTU training but is now in the process of hosting F-35 FTU training and fully divesting from F-16 training ("USAF Selects Luke AFB as F-35 Training Site," 2012). Luke received low ALR values from all pilots. Luke received an aggregate ALR value of -6.2% from all pilots making retention decisions from 2000-2019. Luke’s ALR value was slightly lower for senior pilots and pilots with children compared to mid-career and those without children. Table B.5 lists Luke’s ALR value for each subpopulation.

Table B.5 ALR Values by Subpopulation at Luke AFB

<table>
<thead>
<tr>
<th></th>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
</table>

Source: Original Analysis, 2020
Luke AFB is located outside of Glendale, AZ in the Phoenix-Mesa-Scottsdale MSA. This community has a population of almost five million people in 2019, grew by 18% since 2010 (U.S. Census Bureau, 2020). The twenty highest scoring schools within thirty miles of the base averaged a GreatSchools Summary Rating of 9.7 (GreatSchools, 2020). Given that Luke is located in a large growing community with high quality schools, it is expected to receive a low ALR value. In line with these expectations, Luke AFB is the fourth lowest ALR base included in this study.

Figure B.5 plots Luke’s single-, three-, five- and twenty-year ALR values over time. Luke’s ALR values are generally increasing from 2000 to 2013. Yet despite this upward trend, Luke’s ALR values are predominantly less than zero from 2000-2013, indicating that pilots are more likely to separate from Luke than an average installation. In 2013 Luke began its transition to hosting F-35 training, receiving its first F-35 aircraft. From 2013-2019 Luke’s ALR values are generally decreasing, indicating that pilots are even more likely to separate from Luke than an average installation.

Figure B.5 ALR Values Over Time at Luke AFB

![Figure B.5 ALR Values Over Time at Luke AFB](source)

Source: Original Analysis, 2020
Eglin AFB

Eglin AFB currently hosts F-35 FTU training under the 33rd Fighter Wing, operational test under the 53d Wing, and test under the 96th Test Wing (USAF, 2020). Eglin is a low-ALR base, receiving an aggregate ALR value of -5.314%. Senior aviators were particularly likely to separate from Eglin with an ALR value of -6.303%. Comparatively, mid-career aviators displayed average retention behavior at Eglin, indicated by an ALR value of 0.035%. Pilots with children were also more likely to separate from Eglin, with an ALR value of -6.381%, just less than 4% less than pilots without children. Table B.6 lists the ALR values for each subpopulation.

<table>
<thead>
<tr>
<th>Subpopulation</th>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eglin</td>
<td>-5.314</td>
<td>-0.035</td>
<td>-6.303</td>
<td>-6.381</td>
<td>-2.619</td>
</tr>
</tbody>
</table>

Source: Original Analysis, 2020

Eglin AFB is located in the Crestview-Fort Walton Beach-Destin MSA. This community had a population of 284,809 people in 2019, which grew 20.7% since 2010 (U.S. Census Bureau, 2020). The schools surrounding Eglin average a GreatSchools Summary Score of 9.5 (GreatSchools, 2020). The analysis detailed in chapter five would suggest that Eglin have a below average ALR value, given its location in a large community, growing at an above average rate, surrounded by high quality schools.

Figure B.6 plots Eglin AFB’s single-, three-, five- and twenty-year ALR values over time. The pilot retention behavior of pilots stationed at Eglin has been remarkably consistent since 2000. Despite a transition from F-15C/D to F-35 aircraft in 2009, Eglin’s ALR values have remained relatively unchanged since 2000. Eglin AFB has been a consistently low-ALR installation for the last twenty years.

Similar to Langley, Eglin hosts other substantial missions employing fighter pilots: the 53rd Wing and 96th Test Wing. Perhaps the inclusion of pilots assigned to this unit insulates the base’s ALR values from the effects of a 4th to 5th generation transition. Further research is warranted to further understand the stability of Eglin’s ALR values.
Retention at Prospective F-35 Bases

The F-35 is advertised as the replacement for the Air Force’s aging fleet of F-16 and A-10 aircraft. With the Air Force planning to buy hundreds over the coming years the service will need to stand up new squadrons to operate the new F-35 aircraft (Insinna, 2019). Doing so will require the employment of the Strategic Basing Process to determine the installations that will host the new units. These decisions will affect the Air Force’s ability to complete its mission in addition to significant economic consequences for the communities where new F-35 squadrons will be placed.

As evidenced by the locations of existing F-35 squadrons, the Air Force is prone to stationing new squadrons in the same locations as the units they are replacing. These installations already have much of the infrastructure needed to host fifth generation fighter squadrons, offering the Air Force substantial savings in military construction. Moreover, the Air Force has been consolidating its flying capabilities rather than expanding them since the end of the Cold War. These trends suggest that current domestic A-10, F-15E and F-16 installations are prime
candidates to become future F-35 installations. With this in mind, this section will examine the retention behavior of current A-10, F-15E and F-16 installations to better understand what might happen to that installation’s retention behavior should the base be chosen for a future upgrade to 5th generation aircraft.

Davis-Monthan AFB

Davis-Monthan AFB currently hosts two active duty A-10 squadrons and four rescue squadrons. Davis-Monthan’s A-10 mission entails one training squadron and one combat coded squadron (USAF, 2020). Davis-Monthan is a slightly below average ALR base with an aggregate ALR value of -2.743%. Both mid-career and pilots without children were slightly more likely to separate from Davis-Monthan than senior pilots or those without children. Table B.7 lists the ALR values for each subpopulation.

Table B.7 ALR Values by Subpopulation at Davis-Monthan AFB

<table>
<thead>
<tr>
<th>Subpopulation</th>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
</table>

Source: Original Analysis, 2020

Davis-Monthan AFB is located outside Tucson, AZ, which had a population of just over one million people in 2019. Tucson’s population grew 6.8% from 2010-2019 (U.S. Census Bureau, 2020). Davis-Monthan is surrounded by above-average quality schools, with the highest scoring twenty schools within thirty miles of the installation averaging a GreatSchools Summary Score of 9.4 (GreatSchools, 2020). In line with chapter 6’s findings, Davis-Monthan is an installation located in a large, growing community with high quality schools and received below-average ALR values from each subpopulation.

Table B.7 plots Davis-Monthan’s single-, three-, five- and twenty-year ALR values over time. Davis-Monthan’s ALR values remain moderately consistent from 2000 to 2019. The base’s five-year ALR values range from -5.398% to 1.133%. Davis-Monthan’s fighter mission has remained unchanged since 1994, when the installation started exclusively operating A-10 aircraft. Since 2000 Davis-Monthan AFB has been an average to below average ALR installation, indicating that pilots are slightly more likely to separate from this installation than an average installation.

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29 The USAF does not currently have any 5th generation aircraft permanently stationed overseas. For this reason only domestic F-16 and A-10 bases will be analyzed.
Holloman AFB

Holloman AFB is a fighter base in Alamogordo, NM. Holloman is currently in the process of absorbing the entire F-16 training mission from Luke AFB, and is the only installation to have completed a 4\textsuperscript{th} to 5\textsuperscript{th} generation transition, and then a subsequent 5\textsuperscript{th} to 4\textsuperscript{th} generation transition (USAF, 2014). From 2000 to 2019, Holloman was a below average ALR installation with an aggregate ALR value of -3.327\%. Mid-career and pilots with children were significantly more likely to separate from Holloman than senior aviators or pilots without children. Table B.8 lists Holloman’s ALR values for pilots of each subpopulation.

Table B.8 ALR Values by Subpopulation at Holloman AFB

<table>
<thead>
<tr>
<th>Subpopulation</th>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holloman</td>
<td>-3.327</td>
<td>-6.337</td>
<td>-2.800</td>
<td>-4.269</td>
<td>-0.553</td>
</tr>
</tbody>
</table>

Source: Original Analysis, 2020
Holloman AFB is located in the Alamogordo Micro Statistical Area, which had a population of 67,490 people in 2019 and grew 5.7% since 2010 (U.S. Census Bureau, 2020). The quality of the schools surrounding Holloman are below average, with the twenty highest ranking schools within thirty miles of the installation averaging a GreatSchools Summary Score of 6.4 (GreatSchools, 2020). Given these community descriptors, it is surprising that Holloman is a below average ALR base considering it is located in a smaller than average community, growing at the average rate, with below average quality schools.

Figure B.8 plots Holloman’s single-, three-, five- and twenty-year ALR values over time. ALR values at Holloman have been declining since 2002. Until 2008, Holloman AFB primarily operated the F-117 and experienced above average ALR values. Following the bases transition to the F-22, ALR values at Holloman decreased substantially. Holloman’s five-year ALR value was 2.1% from 2005-2009, but -6.4% from 2010-2014. As the installation divested from the F-22 and received F-16 aircraft in the second half of the 2010s, the bases ALR decreased further. Holloman’s ALR value was -10.5% from 2015-2019. It is unclear what could be responsible for the declining ALR values at Holloman from 2002-2019.

Figure B.8 ALR Values Over Time at Holloman AFB
Shaw AFB

Shaw AFB operates three active duty F-16 squadrons under the 20th Fighter Wing near Sumter, SC (USAF, 2011). From 2000-2019 Shaw was a below-average ALR installation. Shaw received an aggregate ALR value of -3.095% from all pilots making retention decisions while stationed there. Mid-career pilots were 2.2% more likely than senior pilots to separate from Shaw relative to their respective average bases. Conversely, pilots with children were considerably more likely to separate from Shaw than pilots without. This is interesting given that the two trends usually run concurrently. Table B.9 lists Shaw’s ALR values for each subpopulation.

Table B.9 ALR Values by Subpopulation at Shaw AFB

<table>
<thead>
<tr>
<th></th>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaw</td>
<td>-3.095</td>
<td>-4.741</td>
<td>-2.472</td>
<td>-4.626</td>
<td>-1.244</td>
</tr>
</tbody>
</table>

Shaw AFB is located in the Sumter Metro Statistical Area which had a population of 140,466 in 2019. This population shrunk 1.4% since 2010 (U.S. Census Bureau, 2020). The schools surrounding Shaw are slightly below average quality, earning a GreatSchools Summary Score of 6.9 (GreatSchools, 2020). Considering the fact that Shaw is located in a below average sized community, growing at less the average rate, with below average quality schools, it is surprising that the base received below average ALR values.

Figure B.9 plots the single-, three-, five and twenty-year ALR values at Shaw AFB. Shaw’s ALR values have remained relatively consistent from 2000-2019. Shaw’s 5-year ALR estimates ranged from -7.6% to -0.9%. The mission conducted at Shaw was also consistent over that time period, with no major MDS transitions taking place. In 2011 U.S. Army Central integrated onto the installation with the existing Air Force personnel. This change did not coincide with any change in ALR outside of what had been experienced 2000-2010. It is noteworthy that from 2015-2019 Shaw experienced its lowest period of ALR values. It is unclear what could be responsible for this decrease.
Mountain Home AFB

Mountain Home AFB operates three squadrons of F-15E aircraft (USAF, 2020). Mountain Home received average ALR values from all pilots between 2000 and 2019. Pilots of all experience levels and with/without children were equally likely to separate from the installation. Table B.10 lists the ALR values for each subpopulation.

Table B.10 ALR Values by Subpopulation at Mountain Home AFB

<table>
<thead>
<tr>
<th></th>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain Home</td>
<td>-0.720</td>
<td>-0.890</td>
<td>0.026</td>
<td>-1.403</td>
<td>-0.438</td>
</tr>
</tbody>
</table>

Source: Original Analysis, 2020

Mountain Home AFB is located in the Mountain Home Micro Statistical Area. This region had a population of 27,511 in 2019, which grew 1.0% since 2010, and schools averaging a 2.7 GreatSchools Summary Rating (U.S. Census Bureau, 2020; GreatSchools, 2020). Given that the installation is located in a below average sized community, growing at a below average rate, in a
community with the lowest quality schools of any base included in this study, it is surprising that Mountain Home did not receive higher ALR values.

Figure B.10 plots the single-, three-, five and twenty-year ALR values at Mountain Home AFB. Retention outcomes at Mountain Home have been very consistent from 2000 to 2019. The installations five-year ALR values have only ranged from -3.0% to 3.0%, suggesting that Mountain Home consistently demonstrated average retention outcomes compared to the other thirty installations included in this study.

Moody AFB

Moody AFB hosts A-10 and rescue squadrons in the 23d Wing near Valdosta, GA (USAF, 2020) Pilots making retention decisions while stationed at Moody from 2000 to 2019 demonstrated average retention behavior. The installation received an aggregate ALR value of -0.124%, suggesting that pilots were equally likely to separate from Moody as an average base. Mid-career pilots were slightly more likely to separate from Moody than senior aviators. Table B.11 lists the ALR values for pilots of each subpopulation at Moody.

Table B.11 ALR Values by Subpopulation at Moody AFB

<table>
<thead>
<tr>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Moody AFB is located in the Valdosta Metro Statistical Area, which had a population of 147,292 in 2019. The population grew 5.1% since 2010 (U.S. Census Bureau, 2020). The schools surrounding the installation averaged a GreatSchools Summary Score of 6.8 (GreatSchools, 2020). Compared to the other thirty installations included in this study, Moody is located in a smaller than average community, growing at a below average rate, with below average schools.

Figure B.11 plots the single-, three-, five- and twenty-year ALR values at Moody AFB. Moody’s ALR values from 2000-2019 varied from somewhat below average to somewhat above average. Aside from a transition from AETC to ACC ownership, little has changed regarding the base mission in the twenty years studied in this analysis. It is unclear what might be responsible for the variation in ALR values. Perhaps the ALR values are noisy due to the relatively low number of retention decisions made at Moody each year by fighter pilots.

![Figure B.11 ALR Values Over Time at Moody AFB](image)

Source: Original Analysis, 2020
Seymour-Johnson AFB

Seymour-Johnson AFB operates four F-15E squadrons under the 4th Fighter Wing near Goldsboro, N.C.. Two of these squadrons are operational, and two conduct FTU training (USAF, 2020). Seymour-Johnson received average ALR values compared to the other installations included in this study. From 2000-2019 Seymour-Johnson AFB received an aggregate ALR value of 0.001%, indicating that pilots were equally likely to separate from this installation than an average installation. Senior aviators were 2.4% more likely to separate from Seymour-Johnson than an average installation, meanwhile mid-career aviators were 5.0% more likely to be retained at Seymour-Johnson than an average installation. Table B.12 lists the ALR values for pilots of each subpopulation at Seymour-Johnson.

<table>
<thead>
<tr>
<th>Aggregate</th>
<th>Mid-Career</th>
<th>Senior</th>
<th>Children</th>
<th>No Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seymour-Johnson</td>
<td>0.062</td>
<td>4.992</td>
<td>-2.419</td>
<td>0.235</td>
</tr>
</tbody>
</table>

Source: Original Analysis, 2020

Seymour-Johnson is located in the Goldsboro Metro Statistical Area which supported a population of 123,131 in 2019. The Goldsboro population grew 0.4% since 2010 (U.S. Census Bureau, 2020). The schools surrounding Seymour-Johnson averaged a GreatSchools Summary Rating of 7.8 (GreatSchools, 2020). Seymour-Johnson is located in a below average sized community, growing at a below average rate, with slightly above average schools.

Figure B.12 plots the single-, three-, five- and twenty-year ALR values at Seymour-Johnson AFB. ALR values at Seymour-Johnson have been consistently average since 2000. Seymour-Johnson’s ALR values have ranged from -2.5% to 1.7%. Unlike many installations previously discussed there have not been any major mission transitions at this installation since 2000.
Conclusions

The transition from operating 4\textsuperscript{th} to 5\textsuperscript{th} generation aircraft did not uniformly affect installation’s ALR values. Luke, Tyndall and Elmendorf AFBs experienced decreases in their ALR values following 4\textsuperscript{th} to 5\textsuperscript{th} generation transitions. On the other hand Hill AFB experienced an increase in ALR values following its transition. Eglin and Langley AFB’s did not experience any substantive change in their ALR values.

Prospective F-35 installations do demonstrate different retention outcomes, particularly in the last five years. Pilots making retention decisions while stationed at Moody AFB were considerably more likely to be retained than pilots making equivalent decisions at Holloman and Shaw AFBs. If the Air Force were to station F-35 pilots at Moody AFB in the future, it could expect them to be influenced by the same forces that have made pilots more likely to be retained there over the last five years.
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