Project ANNie: Using Artificial Neural Networks as a USAF Force-Multiplier

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Executive Summary

Two decades into the 21st century, technological advances provide the United States Air Force (USAF) with an array of tools for confronting the challenges of tomorrow. Among these technological advances, none provide as much promise, or as much risk, as artificial intelligence (AI) and machine learning (ML). As the private sector, and the United States' potential rivals, continue to develop AI/ML systems, the USAF must begin applying AI/ML into its operations, while navigating the profound ethical and privacy implications that accompany this technology.

This paper proposes a limited use of an AI/ML-driven artificial neural network (ANN) as a method by which the USAF can revolutionize its talent-management and recruitment systems. Specifically, we recommend the USAF develop an ANN, nicknamed "ANNie," programmed to autonomously analyze vast amounts of data in order to recognize and identify correlations between particular traits (or key indicators) and success at various USAF career fields. ANNie would then be programmed to analyze the data of available USAF recruits and officer candidates in order to use trait-matching to identify those recruits/candidates who would be ideal for a given job. This paper identifies pilot candidate selection as a prime field for a small-scale proof of concept to test the idea underlying ANNie. As pilots are the ultimate resource within the USAF, particularly in a time of high pilot attrition, utilizing a system like ANNie to identify the highest quality pilot candidates will be a powerful way to prove ANNie's capabilities.

This paper also discusses various security concerns involved with the use of AI/ML technology, as well as ways in which the use of a system like ANNie can be expanded to analyze wide ranges of USAF career fields, as well as civilian data.

Background

Imagine the United States Air Force (USAF) had an advanced algorithmic system that could determine traits likely to make a person successful in any Air Force Specialty Code (AFSC) and likely to remain in the USAF for a twenty-year career. Further, imagine this system could analyze recruits and officer candidates to determine who among these candidates had traits likely to correlate to success in specific jobs. Imagine still further that this system could be expanded to allow the USAF to analyze the civilian population for the purpose of seeking out and actively recruiting talented individuals possessing traits likely to make them successful Airmen in mission-critical career fields.

While this may sound like science fiction—the sort of imaginary system employed by the Marvel Universe's Nick Fury, or *Men in Black's* Agent K—recent advances in artificial intelligence (AI) and machine learning (ML) technology, coupled with big data analytics, have created astonishing possibilities in the fields of predictive analysis, recruiting, and talent/human resource management. It is no exaggeration to say that a small-scale version of the system described in the preceding paragraph is already well within the realm of possibility. As early as 2012, companies like Target and Amazon were developing systems of predictive analytics to become experts in data analysis, allowing them to predict which products customers will buy and when.

In one famous example, Target was able to identify twenty-five seemingly disparate products—unscented lotion, cotton-balls, and certain dietary supplements, among other items—that, when purchased together by a female subject, indicated a high probability the customer was pregnant (Duhigg, 2012). Both data analysis and AI/ML have advanced dramatically over the past six years. Combining these technologies for the purpose of talent acquisition is already well-established within the private sector. Companies like Ideal, Entelo, and Engage Talent have been applying these technologies to recruitment and talent-sourcing for several years with notable success (Sennaar, 2017). More recently, Eightfold.ai, a company founded by ex-Google and Facebook employees, is seeking to use AI to analyze publicly available data with the goal of creating "picture[s] of an ideal workforce" for almost any industry (Shieber, 2018).

As the USAF (and, more broadly, the United States Department of Defense (DoD) as a whole), considers applications of AI to the profession of arms, it is important to note that American technology and recruitment companies aren't the only ones taking an interest in AI. Potential American rivals such as Russia and China view this technology as the key to future global superiority. Russian President Vladimir Putin has predicted that AI will be "the future, not only for Russia, but for all humankind," and that whatever country first masters AI and its applications will "become the ruler of the world" (Meyer, 2017). This sentiment is shared by the Chinese government, which, in July 2017, released its "New Generation Artificial Intelligence Development Plan"—a three-phase strategy describing China's intention to surpass the United States in the development of AI technology by 2025 (New America, 2017). By 2030, China aims to be "the world's primary AI innovation center" (New America, 2017).

Given this context, AI's potential in military applications has not been lost on the operational USAF. The Department of Defense (DoD) and USAF have recently begun to explore battlefield applications of AI—most notably in the form of Project Maven, a program in which the DoD partnered with commercial companies to leverage AI as a means of providing automated, efficient unmanned aerial vehicle (UAV) video processing and analysis (Simonite, 2018). Project Maven, however, has created widespread controversy in the tech community over the use of AI as a “warfare technology,” and Google, one of the DoD’s key partners in the effort, has already decided not to renew its Project Maven contract (Wakabayashi and Shane, 2018).

Due to the controversy engendered by operations-oriented uses of AI, beginning to leverage AI technology in the human development and recruitment fields has a number of significant advantages. As described above, the technology to revolutionize USAF recruiting and talent sourcing already exists. Further, use of AI for these purposes is likely to be more palatable to the commercial technology companies with which the USAF would need to partner. Moreover, applying AI to human resource management has the potential to provide solutions to key problems currently facing the USAF. This paper seeks to demonstrate the possible application of AI-driven systems to the USAF’s talent-management and recruitment programs by using pilot selection as a proof of concept.

Pilot Selection as a Field for Small-Scale Application of AI

In order to successfully fulfill its core mission sets of air and space superiority, global mobility, and global strike, the USAF requires high-quality pilots. As seen in recent years, and cyclically throughout the USAF’s history, however, producing and retaining pilots is no easy task. The current cost to train a fifth-generation fighter pilot is staggering—up to $11 million per pilot (McCullough, 2017). Though training costs for less-advanced airframes are comparatively cheaper, they are still notably steep: the United States Government Accountability Office (GAO) cites $3 million per pilot as the minimum amount necessary to train a USAF pilot (GAO, 2018). These costs are further exacerbated by trainee attrition during pilot training. Traditionally, as many as 15% of pilot candidates fail to complete pilot training (D. Mace, AETC Flying Training Analyst, personal communication, May 28, 2018). Meanwhile, a strong economy and an increase in commercial airline hiring has resulted in a pilot shortage projected to extend until

2023 (GAO, 2018). It has never been more expensive to train a USAF pilot, nor more difficult to retain one once his or her initial service commitment has elapsed.

This problem has not gone unnoticed or unaddressed. The USAF's Air Education and Training Command (AETC) recently inaugurated the Pilot Training Next program, an expedited training program that seeks to harness advanced technologies as a method of "decreas[ing] the time and cost of training without sacrificing the depth of learning" pilots receive in more traditional pilot training (Strang, 2017). With the goal of halving the length of pilot training and reducing costs by decreasing the number of sorties flown by pilot candidates (largely by supplementing physical sorties with virtual ones), Pilot Training Next seeks to solve the pilot crisis by pushing more pilots through an expedited training pipeline at a lesser cost than traditional pilot training methods. But what if the problem was also addressed using a different lens—finding the pilot candidates least likely to wash out of training programs, more likely to perform well under new pilot training parameters, and more likely to remain in the USAF beyond their initial service commitment?

The use of AI/ML technology to identify pilot candidates with these characteristics would provide a better, more methodical way of selecting candidates for pilot training and could be a critical step in solving the current pilot shortage. For decades, the USAF has been using a variation of a pilot selection methodology that, based on our discussions with Air Force Personnel Center representatives, lacks scientific rationale (H. Acosta, personal communication, May 22, 2018). The selection criteria are a mixture of six weighted components: a candidate's Commander's ranking, undergraduate grade-point average (GPA), Pilot Candidate Selection Method (PCSM) score, physical fitness assessment (PFA), and field training performance. For some pilot candidates, largely subjective criteria such as the Commander's ranking can account for 50% of the candidate's overall board selection score (BaseOps, 2016). While the USAF has utilized this system to good effect, these criteria are inadequate to fully encompass the range of data, traits, and skills that characterize the best pilot candidates. If the United States is to maintain its competitive advantage over its potential adversaries, and if the USAF is to preserve its position as the world's preeminent Air Force, a better, more advanced system is needed to find pilot candidates likely to succeed and thrive in the cockpits of the future. Because of the significance of pilot selection and retention to the USAF's overarching mission, we have focused on pilot selection as an area in which we can apply our proposed system, an AI-driven artificial neural network (ANN), as a proof of concept for the future, more widespread, use of AI/ML in USAF recruiting and talent management.

Proposal

The USAF should capitalize on technological advances in AI/ML and big data analytics to improve the pilot selection process by creating an AI-driven ANN capable of analyzing a wide range of data related to pilot selection and performance. The purpose of this ANN, which we have nicknamed "ANNie," would be to recognize correlations between particular traits and success at pilot training, and to use trait-matching to make USAF pilot training program candidate recommendations.

What is an Artificial Neural Network (ANN)?

While a full explanation of the coding and technology underlying ANNs is beyond the scope of this paper, a rudimentary understanding of ANNs is necessary to frame our proposal and to provide the reader with context regarding such a system's capabilities. At the most basic level, an ANN is an AI algorithmic system modeled after a human brain, with artificial neurons connected together in ways emulating the connections between biological neurons. An ANN system utilizes multiple "layers" of neural nodes to draw inferences from the data fed into the system for analysis. In its simplest form, an ANN will have at least three layers: an input layer, "in which input data groups are introduced to the network"; a hidden layer, in which data is processed, organized, and analyzed; and an output layer, in which the data received from the hidden layer is further processed to result in "output values" for the question or problem the ANN was tasked with addressing (Staub et al, 2015, p. 1479). More advanced ANNs may be programmed with even larger numbers of layers, allowing the system to use what is referred to as "deep learning" (the word "deep" describing the depth of layers the system uses to build its conclusions) to learn ever-more complicated and abstract features (Namatēvs, 2017, p. 40).

ANNs are extremely useful because, like the human brains they mimic, they are "capable of processing and learning . . . , accepting constant data input, and seeking conclusions by using current information in case of insufficient data" (Staub et al, 2015, p. 1484). ANNs are capable of training themselves to recognize relationships between their inputs and outputs, modifying their data interpretations as necessary to address different tasks or problems, and utilizing connections they have made between data points to draw general conclusions about problems for which they may not have received direct data inputs (Staub et al, 2015, p. 1479). Because of these capabilities, ANNs are extremely effective at "mak[ing] sense out of complex, noisy, or nonlinear data" and can "provide robust solutions to problems . . . involving classification, prediction, filtering, optimization, pattern recognition, and function approximation" (Simoneau & Price, 1998). In other words, although modeled after the human brain, ANNs can recognize patterns and make predictions based off of correlations between data inputs that human beings are simply incapable of recognizing by applying traditional analytic methods.

Development of ANNie

In the "Background" section of this paper, we cited a number of private sector companies currently utilizing AI-driven systems for recruiting and talent management. In order to make ANNie, our proposed ANN, a reality, the USAF could likely find a civilian partner to assist with the coding and development of ANNie's underlying systems and algorithms. Partnering with commercial companies in a manner similar to (although, hopefully, less controversial than) the partnerships the DoD established with private enterprise for technological assistance on the AI-driven Project Maven (Simonite, 2018) would likely be the best, fastest way for the USAF to develop, or outsource the development of, a prototype version of ANNie. That said, as the purpose of this paper is not to provide a roadmap for the acquisition of an AI-driven ANN, but, instead, to explore the possibilities that such a system holds for USAF recruitment and talent-management, let us assume two things: first, that ANNie can be programmed to accomplish the tasks described below, and, second, that ANNie can be developed and programmed at a reasonable cost to the USAF.

Pilot Candidate Selection Proof of Concept

The application of ANN technology to the pilot selection problem described above would be a process comprised of multiple stages:

First, since the ultimate goal is to use ANNie's predictive analysis to select successful, committed pilot candidates, ANNie would need to be trained to recognize successful pilot attributes. During this "Discovery" stage, data scientists would need to provide relevant data from "successful" pilots into ANNie's input layer. Alternatively, ANNie could be linked to existing USAF networks and systems in order to pull and filter certain data automatically. This data could be gleaned from a variety of sources. Officer Performance Reports (OPRs), PCSM scores, training records, records related to secondary and post-secondary education, "below-the-zone" (BTZ) promotions, and awards are initial examples of traditional USAF records that could be used an input data. This traditional data, however, may be of only minimal use in achieving the underlying purpose of the "Discovery Stage": using ANNie's predictive analysis to reveal truly revolutionary information concerning unique traits or skills (or unique combinations of traits and skills) that make a person likely to succeed as a pilot. Returning to the Target pregnancy-prediction example cited above, we are searching for the seemingly disparate indicators—the cotton balls purchased in conjunction with wash cloths or supplements—that correlate, not to pregnancy, but to enhanced pilot performance. In order to find these key indicators, which may never have been recognized or even considered before, it is likely that we will need to cast a wider net and analyze non-traditional data sources. Non-traditional input data could include social media posts, personality profiles, friend and family relationships, reading habits, musical tastes, and other, more seemingly esoteric data sets.

One of the beauties of the "Discovery" stage is that the types of data ANNie can analyze and the parameters of the conclusions ANNie can draw are limited only by our imaginations. Input data sets can be as varied we wish, and, as technology continues to advance, new data sets can be used to augment ANNie's analysis. For example, part of a recent research project conducted by Maj Travis Sheets and Maj Matthew Elmore, two USAF Air Command and Staff College (ACSC) students, utilized ML technology developed by Senseye Inc. to measure the eye movement of subjects flying within virtual-reality flight simulators in an attempt to determine their cognitive load (2018, p. 68-73). Although this technology is still in its infancy, imagine how data assessing biological reactions to virtual environments could be analyzed by ANNie and correlated to other indicators of pilot success. Further, output data sets can be sorted by analyzing unique traits of pilots that fall into various categories. What are the unique traits of the top 10% of pilot training graduates? The top 30%? Twenty-plus-year career pilots who have served as Base Commanders? B-2 pilots particularly? Different permutations of output data can be used to determine various categories of traits that correlate to success for different sub-classes of USAF pilots.

The second stage, "Analysis," uses the traits and characteristics identified by ANNie in the "Discovery" stage to analyze an available pool of pilot candidates. For our proof of concept, we recommend beginning with potential pilot candidates at the United States Air Force Academy (USAFA), Officer Training School (OTS), and Reserve Officers' Training Corps (ROTC). Candidates within these pools would already have provided significant amounts of personal data to the USAF, and obtaining additional data—for instance, access to social media sites, personality information, etc.—would be both feasible and unlikely to result in negative public perception. This data from the USAFA, OTS, and ROTC candidate pools would be uploaded into ANNie's input layer (or, again, input through some automated process if the data existed in a form ANNie could be programmed to access herself) and then analyzed against the traits and characteristics ANNie identified as correlating to "successful" pilot candidates. ANNie's output in the "Analysis" stage would serve as a trait comparison: ANNie would determine which USAFA, OTS, and ROTC candidates exhibit some or all of the traits identified in the Discovery stage.

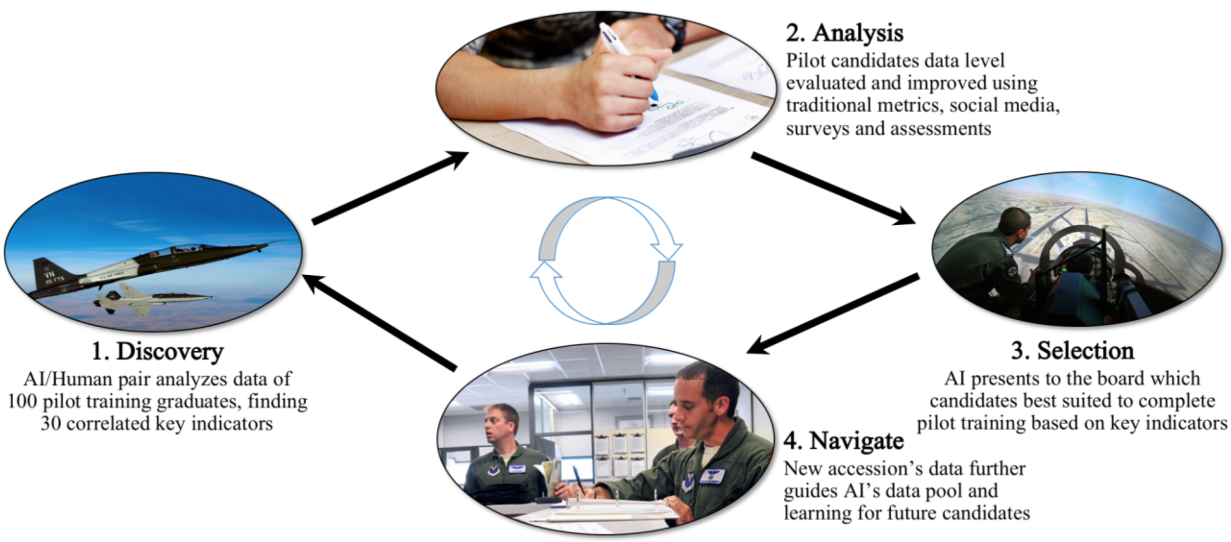
The "Analysis" stage would lead naturally to the third stage of our proof of concept, the "Selection" stage. This stage would occur at the time a rated pilot selection board meets to determine which available candidates will actually be selected into pilot training. While ANNie's analysis and recommendation would never replace the selection board, our goal at this stage would be to present a board with two lists of candidates: a list of candidates likely to be selected using the USAF's traditional selection criteria and a list of candidates who exhibit the traits identified by ANNie as correlating to success in pilot training. It is certainly possible that some, or even many, of the candidates named on the first list could be found on the second. Regardless, the aim would be to provide selection boards with the ability to select pilot trainees based on a defensible analysis of their traits and skills, rather than more nebulous criteria like the candidate's Commander's ranking.

The final stage of our proof of concept is especially exciting. This "Navigate" stage provides the opportunity to follow and track the performance of the pilot trainees recommended by ANNie, continually feeding data regarding their successes—and failures—into ANNie's input layer for additional analysis. Via this process of persistent data feedback and analysis, ANNie can further refine her algorithms to account for mistakes (say, a recommended pilot candidate who was selected for training but ultimately was unsuccessful at completing the syllabus) or to identify additional traits exhibited by successful trainees that may not have been identified in her original analyses. ANNie's ability to continuously learn from the data provided to her inputs allows her analytical processes to function in a loop. At the end of the "Navigate" stage, the new data collected from the recently-selected pilot trainees flows into ANNie's input layer, where ANNie will begin the four-stage process over again, using the new data as fodder for a new "Discovery" stage.

To offer a theoretical example of how the four stages of our proof of concept would work in practice, imagine the following scenario, depicted pictorially in Figure 1, below. The USAF identifies 100 recently-trained pilots who were extremely successful at pilot training and in their early post-training assignments. Data from these 100 pilots is provided to ANNie, initiating the

"Discovery" stage. In conjunction with her programmers, ANNie uses her AI-driven analytics system to identify 30 traits, personality features, or other characteristics that appear to correlate to success in pilot training. With these 30 traits in hand, the "Analysis" stage begins: data from, say, 2000 potential pilot candidates is input into ANNie and analyzed against the 30 traits previously identified. At this point ANNie determines that approximately 125 candidates exhibit some or all of the traits identified during the "Discovery" stage. ANNie's recommendations regarding these 125 candidates are presented to a selection board during the "Selection" stage, along with a list of the candidates likely to be selected under the USAF's traditional selection criteria. Of the 125 candidates recommended by ANNie, the board selects 90 to continue to pilot training. Data from the performance of these 90 trainees is then continuously fed back into ANNie's input layer, enabling ANNie to reinitiate the "Discovery" phase—refining her analysis of what does and does not correlate to success in pilot training and beginning the process over again.

Figure 1: Pilot Candidate Selection via ANNie



Security Concerns and Potential Mitigation Strategies

As our proof of concept shows, ANNie's ability to evolve and revolutionize pilot candidate selection is profound; however, the benefits of utilizing an ANN system like ANNie are not without risks.

Security Implication of AI-Driven Systems

In 2018, experts at the University of Oxford examining malicious uses of AI determined AI technology will transform the threat landscape in the digital, physical, and political security domains to expand existing threats, introduce new threats, and alter the typical character of threats (Brundage et al, 2018, p. 18). Many of the characteristics that make AI advantageous—efficiency (the ability to "complete a certain task more quickly or cheaply than a human could"), scalability (the ability of an AI system to "complete many more instances of [a given] task" if the system is duplicated or provided with additional computing power), and ease of diffusion (AI algorithms and software packages can be transmitted through open-source networks, allowing fast and easy duplication)—also provide significant vulnerabilities that can be exploited by bad actors (Brundage et al, 2018, p. 16). These characteristics transform the digital security domain by allowing traditionally man-power intensive operations like social engineering, vulnerability discovery, and hacking to become automated by AI (Brundage et al, 2018, p. 24-25). Within the physical domain, AI provides skilled capabilities to otherwise low-skilled adversaries, lessening training requirements for state actors or empowering non-state actors (Brundage et al, 2018, p. 27). Finally, AI can be a threat to political security through the automation of disinformation, influence, and denial of service campaigns (Brundage et al, 2018, p. 29). Ultimately, AI provides a means for malicious actors to engage in cyber and AI-driven attacks at a lower cost of entry with higher scope and frequency.

AI operates in cyberspace to achieve its effects. At an abstract level, ANNie will be comprised of a host cognitive processing system interconnected through cloud computing to receive and interface with vast and voluminous data sources. Despite their advanced technologies and capabilities, the processing and networking infrastructures that allow ANNie to operate are susceptible to traditional cyberspace vulnerabilities. As an interactive and networked service hosted on a system, ANNie will be vulnerable to memory overflows (attacks that take advantage of program input limitations by overriding program code to gain control of the system) and network attacks (attacks leveraging network protocols to limit traffic within the cyber network or stop it altogether) (Brundage et al, 2018, p. 83). ANNie may also be vulnerable to zero days—undiscovered vulnerabilities in programs that can be exploited to provide a malicious actor unintended access and privileges (Brundage et al, 2018, p. 83).

In addition to traditional cybersecurity concerns, ANNie will likely be vulnerable to AI-specific vulnerabilities in the areas of data input and output, "such as inducing misclassification via adversarial examples or via poisoning the training data" (Brundage et al, 2018, p. 82-83). Inducing misclassification via adversarial examples means providing the AI with "inputs designed to be misclassified by machine learning systems" (Brundage et al, 2018, p. 17). Corrupting a digestible data input can lessen the AI's effectiveness at learning and making decisions. Poisoning the training data means providing false information to manipulate AI learning. For example, a malicious cyber actor could taint the characteristics of successful pilot candidates, causing ANNie to look for erroneous data points. Data output from the AI is vulnerable from an operational security perspective. First, the traits and key indicators ANNie determines are indicative of pilot success (or success in other career fields) could be incredibly valuable to adversarial actors. Malicious actors like China, North Korea and Russia would benefit greatly from such data outputs especially if it doesn't require the cost of actually building, teaching and securing the AI. Second, ANNie's data output could serve as an operational security concern by identifying the theoretically "best" Airmen for fighting the nations wars. Were our adversaries able to obtain this information, these Airmen could be targeted in an attempt to tarnish, or even eliminate, the USAF's "best of the best."

Possible Mitigation Measures

If ANNie is going to be utilized to safely and effectively predict the USAF's best possible pilot candidates, the USAF must develop countermeasures to address the adversarial threats and vulnerabilities described above. There are a number of potential mitigation measures the USAF could employ. First, as the Oxford workshop recommended, "Policymakers should collaborate closely with technical researchers to investigate, prevent, and mitigate potential malicious uses of AI" (Brundage et al, 2018, p. 51). In crafting procedures for ANNie's application, USAF policymakers will need to create policies that promote ANNie's cybersecurity. This could include things like programming vulnerability detection into ANNie's code (Brundage et al, 2018, p. 35), or even by hosting "bug bounty" competitions to locate coding vulnerabilities within ANNie's systems—something similar to the USAF's "Hack the Air Force" competition, in which monetary "bounties" are paid to teams who can find vulnerabilities in the code (U.S. Department of Defense, 2017). Further, as the Oxford experts note, consumer awareness is a critical factor in cybersecurity: "more aware users can spot telltale signs of certain attacks" (Brundage et al, 2018, p. 35). Applying this concept, ANNie's system administrators and even the recruiters using ANNie's outputs could be educated to know what healthy output data should look like and how to report anomalous behavior. Additionally, AI researchers and engineers need to proactively think and integrate mis-use considerations into policy and implementation for ANNie (Brundage et al, 2018, p. 51). Finally, in its implementation of ANNie, the USAF needs to "[a]ctively seek to expand the range of stakeholders and domain experts involved in discussions of these challenges" (Brundage et al, 2018, p. 52). Social profile experts, cybersecurity experts, AI startups and ethicists may all provide valuable insight and speculative mis-use considerations for future implementation concerns.

Future Implications

Although the development of an AI-driven ANN like ANNie presents cybersecurity and other challenges, using ANNie for pilot candidate selection is an extremely exciting prospect. Even more exciting, however, are the almost limitless possibilities presented by applying ANNie's analytical powers more broadly. As ANNie's success at pilot selection is proven over time, and as ANN technology is further refined, ANNie's use can be expanded to encompass new questions, new goals, and new career fields.

Expanded Use to Other USAF AFSCs

Limiting ANNie's initial use and analysis to the field of pilot candidate selection will prove the concept of using AI-driven ANN technology as a USAF talent-management tool. The ultimate goal of this proof of concept, however, is much more ambitious: expanding the use of ANNie's AI-driven trait analysis beyond pilot selection to eventually encompass all USAF AFSCs. With sufficient data, ANNie could identify traits and key indicators of success for any job in any career field. It is even possible ANNie could even identify an ideal candidate for an AFSC an individual had never previously considered. After ANNie's application is proven successful under our pilot selection proof of concept, we envision a slow expansion of AI-driven talent management into other career fields. This would begin with smaller, critical officer career fields (such as Special Operations Forces, RPA operators, etc.), then move into other officer career fields, broaden into enlisted career fields, and, finally, become standard procedure for talent-management and advanced career-selection throughout the USAF.

ANNie's expansion into other career fields will be aided by the Air Force Learning Services Ecosystem (AFLSE), an existing AETC project leveraging technological advances in cloud-computing to create a more accessible, more organized system for force development. The AFLSE will soon serve as "a centralized location to record all learning, whether it occurs in a specialized training or education program, on-the-job, or even off-duty" (Mihalik et al, 2018, p. 10). The goal of AFLSE is to serve as an innovative and continuous replacement for the USAF's outdated training systems, using a vast array of applications connected to the cloud to provide "ubiquitous learning opportunities" and "ready access to advanced educational technology," all of which would be tracked within the individualized Airmen's Learning Record (ALR) (Roberson and Stafford, 2017, p. 11). While AFLSE may have been created as an advanced method of pushing and tracking training and education, the wide range of data collected and stored by AFLSE will also prove to be extremely valuable for providing continuous inputs for ANNie as she analyzes various USAF career fields, matching recruits, trainees, and Airmen to jobs at which they are likely to excel.

"Active Recruiting"—The Future of USAF AI-Driven Recruitment

In the description of our pilot candidate selection proof of concept, above, the proposed data inputs analyzed by ANNie in both the "Discovery" and "Analysis" stages came from either current USAF members or current officer candidates in the USAFA, OTS, or ROTC. What if, rather than solely focusing on individuals already pursuing a career with the USAF, ANNie had a way of gathering data from talented civilians—particularly those who may never have considered joining the USAF? Harnessing ANNie's analysis of this civilian data would allow the USAF not merely to manage the talent of current recruits and officer candidates; it would provide a revolutionary method of recruiting by which the USAF could identify potential recruits among the civilian population.

AETC is already exploring methods of obtaining data from young potential recruits. In late May 2018, Lieutenant General Steven Kwast, the AETC Commander, described one such method—an online video game, currently under development, that could be used to gauge a player's skills and attributes, allowing unique insights into their potential success in the USAF:

> "When someone says, 'I want to be a pilot in the Air Force,' and they're out in high school or college, I can have them play a game online, and that game gives me insight into their skill, their knowledge, their attributes and their characteristics," Kwast said. "I don't need to know their name, but I know that IP address so-and-so has really got unique skills to be a helicopter pilot, or to be an F-35 pilot, or whatever it might be. And then I can start recruiting that person and marrying up their propensity, their passion and their talents with my requirements in the Air Force" (Losey, 2018).

Based on Lt Gen Kwast's description, this proposed video game seems tailor-made to provide the kinds of data inputs ANNie would need to begin analyzing civilians for the purpose of identifying promising potential USAF recruits.

While the USAF would certainly need to navigate ethical and privacy concerns in any recruitment effort that involved the collection of civilian data—a point that Lt Gen Kwast emphasized in his description of the proposed video game described above (Losey, 2018)—the possibilities that this data holds for future USAF recruitment cannot be understated. To return to our examples of pilot selection and critical career fields like cyber, imagine a future data collection system in which the USAF had ethical ways to collect data on promising middle- and high-school students, perhaps by using data-sourcing partnerships with youth-oriented aviation and science, technology, engineering, and mathematics (STEM) organizations likely to contain promising potential USAF recruits. Examples of such organizations include the Federal Aviation Administration's Aviation Career Education Academy, which has programs for elementary through high school students, and CyberPatriot, a youth cyber education program created by the Air Force Association, among many others. If the USAF could partner with these organizations and, with parent approval, obtain data related to a child's performance in these programs, the process of analyzing a potential recruit for some of the USAF's most critical career fields could begin as early as elementary school.

This future vision of a USAF recruitment program harnessing ANNie's analytical powers to seek out and analyze civilian data for the purpose of actively recruiting civilians into the USAF will likely require data partnerships, synching USAF databases with ANNie, and determining algorithms that yield optimal results.

Conclusion

As the USAF prepares to face the challenges of modern warfare in the mid-21st century, advances in AI/ML provide an opportunity to harness cutting-edge technologies as essential tools, not only in the kinetic and operational realms, but in the everyday management of its most vital resource: its Airmen. This paper has offered a vision for how the use of an AI-driven ANN, ANNie, could revolutionize the USAF's talent management and, ultimately, recruiting processes. Since its inception, the USAF has been able to harness the popular imagination to actualize technologies and capabilities that were once solely within the realms of fantasy science fiction. Right now, progress within the private sector and by the United States' near-peer competitors threatens to outpace the USAF in use and application of AI technology. The USAF must seek out opportunities to ensure that it remains on the cutting-edge of these technological applications; the use of AI/ML as a tool for talent-management and recruitment is a perfect, relatively uncontroversial place to start.

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