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IMPORTANT AND CRITICAL PSYCHOLOGICAL ATTRIBUTES OF USAF MQ-1 PREDATOR AND MQ-9 REAPER PILOTS ACCORDING TO SUBJECT MATTER EXPERTS

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14. ABSTRACT

Among U.S. Air Force remotely piloted aircraft, the MQ-1 Predator and MQ-9 Reaper have emerged as critical assets to intelligence, surveillance, reconnaissance, and close air support operations. The effective selection of Predator/Reaper pilot training candidates for such aircraft is essential to successful training and operational performance. However, a profile of "the right stuff" (i.e., cognitive aptitudes, personality traits, and motivation) guiding aeromedical flight screening and selection processes for such pilots does not exist. This study addresses the gap in the literature by formulating such a profile based upon the input of line commanders and subject matter experts (SMEs). A total of 82 SMEs provided input on the psychological attributes perceived as critical to acquisition of Predator/Reaper pilot skills, as well as adaptation to the operational environment. The researchers analyzed, organized, and integrated the results of SME interviews in to a theoretical, multidimensional profile, which serves as a communication tool between aeromedical leadership and line commanders regarding psychological attributes that should be considered prior to a Predator/Reaper pilot training applicant entering the career field. The profile may also guide aeromedical and personnel assessment and selection procedures, as well as waiver evaluations to reduce attrition, and improve retention in such a high-demand, high-operational aviation career field.

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1.0 EXECUTIVE SUMMARY

Among the variety of U.S. Air Force remotely piloted aircraft (RPA), the MQ-1 Predator and MQ-9 Reaper have emerged as critical assets to intelligence, surveillance, reconnaissance, and close air support operations. The effective selection of Predator/Reaper pilot training candidates for such aircraft is essential to successful training and operational performance. However, a profile of "the right stuff" (i.e., cognitive aptitudes, personality traits, and motivation) guiding aeromedical flight screening and selection processes for such pilots does not exist. This study addresses the gap in the literature by formulating such a profile based upon the input of line commanders and subject matter experts (SMEs).

A total of 82 SMEs (e.g., RPA Predator/Reaper commanders, rated pilots, sensor operators, and mission intelligence coordinators, as well as training instructors) provided input on the psychological attributes perceived as critical to acquisition of Predator/Reaper pilot skills, as well as adaptation to the operational environment. The researchers analyzed, organized, and integrated the results of SME interviews in to a theoretical, multidimensional profile.

The profile of critical psychological attributes consists of: (a) *Cognitive ability* (e.g., speed of information processing and accuracy; visual-perceptual recognition, tracking, and analysis; sustained and divided attention to visual/auditory information; spatial processing; working, immediate, and long-term visual/auditory memory; real time deductive reasoning; and psychomotor reaction time; (b) *Intrapersonal personality traits* (e.g., emotional composure, resilience, self-certainty, conscientiousness, perseverance, success-orientation, decisiveness, and adaptability: (c) *Interpersonal personality traits* (e.g., humility, comfort and confidence in working in groups, social cautiousness and prudence, and team orientation; and (d) *Motivation* (e.g., moral and occupational interest in saving lives and sense of duty as a military officer).

The multidimensional profile based upon SME input serves as a communication tool between aeromedical leadership and line commanders regarding psychological attributes that should be considered prior to a Predator/Reaper pilot training applicant entering the career field. The profile may also guide aeromedical and personnel assessment and selection procedures, as well as waiver evaluations to reduce attrition, and improve retention in such a high-demand, high-operational aviation career field.

2.0 INTRODUCTION

Recognizing the capabilities of U.S. Air Force (USAF) remotely piloted aircraft (RPA), the USAF is fully committed to increasing and expanding such operations across theaters of conflict (i.e., Iraq and Afghanistan) and areas of national interest (i.e., Africa). Among the variety of USAF RPAs, the MQ-1 Predator and MQ-9 Reaper airframes have emerged as the most dominant weapon-bearing platforms in support of aerial intelligence, surveillance, reconnaissance (ISR) and close air support (CAS) operations. As a result, USAF MQ-1 Predator and MQ-9 Reaper pilots represent a critical asset to operations in theaters of conflict and in a uniquely challenging, high-demand, high-precision profession. To illuminate the significant tasks associated with MQ-1 Predator pilot duties, a comprehensive pilot job analyses has been conducted (Nagy JE, Kalita SW, Eaton G, *U.S. Air Force Unmanned Aircraft Systems Performance Analyses, Predator Pilot Front End Analysis (FEA) Report*, SURVIAC-TR-06-203, Feb 2006; available through the Defense Technical Information Center to U.S. Government agencies and their contractors only). However, there is no clearly established list of inherit

psychological attributes identified as critical to pilot training, skill acquisition, and adaptation to such a unique combat-oriented RPA platform. The identification of a core set of psychological attributes is essential to identifying USAF commissioned officers who are aeromedically suitable for RPA operations and who are likely to thrive in such a unique and critical role.

As reported earlier by Chappelle, Novy, Sowin, and Thompson (Ref 1), military flying in support of combat and/or humanitarian missions is an extraordinary profession requiring a special set of traits and talents. It is perceived by many that those who desire to become military pilots possess high levels of courage, self-discipline, aggressiveness, self-confidence, and a strong interest in high-risk activities. These traits are believed to accompany a superior level of intelligence, dexterity, coordination, and reflexes that are combined with a strong motivation to fly. This particular picture of a pilot has been portrayed in novels (e.g., Ref 2) as well as films (e.g., "The Right Stuff" and "Top Gun") and is a common perception among military leadership and civilians. Having an accurate assessment of the cognitive aptitudes and personality traits of USAF pilots is important to aeromedical providers tasked with evaluating rated pilots and training applicants and making decisions about whether such persons are aeromedically suitable to pursue such a challenging and high-risk occupation. However, our current understanding of the psychological attributes (i.e., cognitive aptitudes and personality traits) considered critical to performance is based upon pilots in manned airframes (e.g., fighter/bomber, tanker/transporter, and surveillance/reconnaissance). At the present time, our understanding of such traits and attributes among pilots of unmanned airframes is very limited.

A psychological profile that explicates cognitive abilities, personality traits, and motivation that distinguish MQ-1 Predator and MQ-9 Reaper pilots from pilots of manned aircraft would serve as a powerful tool for identifying training candidates and incumbents likely to thrive in such a unique and challenging occupation. The purpose of this study is to: (a) elicit the input of USAF subject matter experts (SMEs) (e.g., line commanders, pilots) from active duty training and operational squadrons and (b) systematically organize their input into a comprehensive, multidimensional list of psychological attributes considered important or critical to MQ-1 Predator and MQ-9 Reaper pilot performance.

2.1 Description of MQ-1 Predator and MQ-9 Reaper

The MQ-1 Predator is a medium-altitude, long-endurance RPA originally developed to meet demands from the USAF and Central Intelligence Agency (CIA) for a quiet, versatile, unmanned reconnaissance aircraft. The original unarmed version was labeled the RQ-1 and has been in use for over a decade. However, the aircraft was renamed MQ-1 in 2005 when it was equipped with weapons (e.g., laser-guided missiles) capabilities. The addition of weapons expanded the aircraft's ISR role to precision-strike operations, such as CAS. Although MQ-1 Predator missions are conducted by the USAF and CIA in support of operations in theaters of conflict, other government agencies such as the U.S. Border Patrol utilize unarmed versions of the Predator.

The MQ-1 Predator RPA crew consists of a pilot who controls the movement of the vehicle and an enlisted sensor operator (SO) in charge of reconnaissance and targeting, as well as a mission intelligence coordinator for communicating and relaying key sources of information. The MQ-1 Predator is remotely piloted from a ground control station (GCS). It is equipped with multiple full-motion video cameras for day and night use and variable weather. It is also fitted with an advanced targeting system that includes electrooptical, infrared, laser designation, and

laser illumination capabilities. The MQ-1 Predator is roughly the length of a Cessna 172 civilian aircraft. It is 27 ft long and 6.9 ft tall and has a wingspan of slightly longer than an F-15E Strike Eagle. The aircraft is disassembled for transport, as needed. The MQ-1 Predator travels at high speeds, which may vary depending upon weather and wind conditions, and loiters over a target for up to 24 hr. The aircraft has an operational ceiling of 25,000 ft and can be configured to carry two laser-guided AGM-114 Hellfire anti-tank missiles (Ref 3).

The strategic role of the MQ-1 Predator in both ISR and precision-strike missions fostered demand for the MQ-9 Reaper. The MQ-9 Reaper is a high-altitude, long-endurance airframe designed as a "hunter-killer" aircraft with enhanced capabilities for identifying, targeting, and destroying enemy combatants and assets considered time-sensitive targets. The MQ-9 Reaper flies higher and faster and is more heavily armed and versatile than the MQ-1 Predator. The MQ-9 Reaper is roughly the size of an F-16 fighter with a length of 40 ft and a height of 16 ft. The MQ-9 Reaper features the same types of cameras as the MQ-1 Predator along with synthetic aperture radar that allows observation and targeting of points of interest on the ground, even when poor weather conditions obscure the target. The aircraft can travel at high rates of speed and at an altitude as high as 50,000 ft (Ref 4)

The MQ-9 Reaper weapons payload may be configured in any number of ways with up to eight AGM-114 Hellfire missiles, four 500-lb GBU-12 Paveway II laser-guided bombs, or two GBU-38/B Joint Direct Attack Munition bombs. It can also be configured to carry other weapons, such as AGM-65 Maverick air-to-surface missiles, AIM-9 Sidewinder air-to-air missiles, and AIM-120 Advanced air-to-air missiles. The versatility in weapons configurations provides flexibility to air combatant commanders and ground units requesting assistance. It may also be equipped with a variety of sensors and cameras, dependent upon the needs of the mission.

2.2 Aerial Combat Demands for MQ-1 Predator and MQ-9 Reaper Operations

Since the onset of Operations Enduring and Iraqi Freedom, the MQ-1 Predator and MQ-9 Reaper have served multiple roles in the gathering of imagery and streaming video to support ISR, CAS, and various precision-strike operations. Such aircraft provide real time information to commanders for identifying fixed and moving targets, tracking enemy movements and assets, tracking and/or eliminating enemy combatants, catching insurgents planting roadside bombs, locating and destroying weapons caches, directing and protecting ground forces, safeguarding convoys, augmenting manned-strike missions, and surveying post-strike battle damage (Ref 5). USAF leadership lauds the role of RPA airframes as complex force multipliers with dynamic air combat capabilities while shielding crewmembers from the traditional aviation-related threats to personal safety (Ref 6).

Within the last 5 yr, the number of MQ-1 Predator and MQ-9 Reaper missions and combat air patrols (CAPs) sustained 24 hr a day, 365 days a year has increased dramatically, as shown in Figure 1. The increase is reflective of USAF military operations becoming more reliant upon the decisive advantages of such airframes (Ref 4). The success of the MQ-1 Predator and MQ-9 Reaper as well as other RPA airframes (e.g., Global Hawk) has influenced Department of Defense (DoD) budget allocations beyond amounts requested by the USAF (Ref 7). The increased acquisitions budget and devotion to further development reflect the DoD and Department of the Air Force vision that RPA operations will dominate aerial battle space in the 21st century (Ref 8-10).

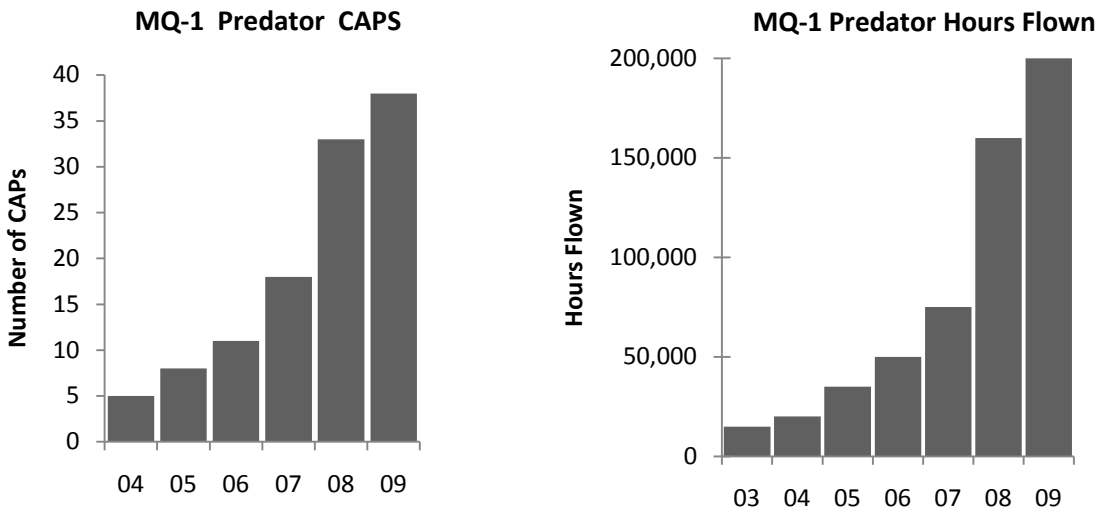

Figure 1. Combat Air Patrols and Mission Hours Flown by MQ-1 Predator

2.3 General MQ-1 Predator and MQ-9 Reaper Pilot Duties

As can be surmised from above, USAF MQ-1 Predator and MQ-9 Reaper pilots are central to effective identification, surveillance, targeting, weapons deployment, and battle damage assessment of enemy combatants and assets. Such pilots perform a wide range of manual and computer-based tasks to actively and/or passively control, maneuver, and fly the aircraft (see Nagy et al., p. 1). Specific duties include, but are not limited to, the following:

- Performing preflight and in-flight mission planning activities in accordance with unified combatant command and theater rules of engagement
- Understanding tactics, techniques, and procedures for friendly and enemy air order of battle (AOB) assets
- Receiving, interpreting, extracting, and disseminating relevant air tasking orders, airspace control orders, and spins information
- Ensuring airframe and supporting GCS systems for controlling the aircraft are operating efficiently and effectively
- Performing checklists and monitoring systems controls during aircraft launch and recovery operations
- Flying the aircraft en route to airspace of national interest while coordinating with air traffic control, as well as other aircraft and aircrew
- Maneuvering the aircraft to gather surveillance and reconnaissance data over targets and areas of interest
- Maneuvering the aircraft into strategic positions for the deployment of weapons (e.g., close air support of ground troops)

- Assisting in air navigation, AOB integration, fire control planning, and determining effective weapons control and delivery tactics to achieve mission objectives
- Receiving target briefs for weapons delivery and conducting battle damage assessments (BDAs)
- Maintaining situational awareness to target imagery, friendly and enemy orders of battle, and offensive and defensive capabilities from various sources
- Assembling target information, locating forces, and determining hostile intentions and possible tactics

See Figure 2 for a simplified breakdown of major workflow tasks for MQ-1 Predator pilots.

This position requires the pilot to visually discriminate and synthesize various images and complex data on several electronic screens while maintaining heightened vigilance to numerous sources of visual and auditory information necessary for sustaining situational and spatial awareness. The pilot must attend to visual-spatial two-dimensional input while performing numerical calculations for maneuvering the aircraft in addition to sustaining vigilance to multiple sources of visual and auditory input. The pilot must be attentive to several procedural checklists and processes with advanced computer systems while simultaneously translating two-dimensional information from video screens into spatial imagery. Despite the automated nature of many of the operations, the pilot in many situations must manually maneuver the aircraft (e.g., strategic deployment of weapons, BDA, positioning of surveillance, avoidance of bad weather, controlling the aircraft during equipment or systems failures, etc). In short, pilots must rely upon a wide range of cognitive aptitudes when carrying out their duties in a confined environment with specific rules of engagement, tactics, and techniques. For a more in-depth analysis of the major job tasks and duties of a pilot, please see Nagy et al., p. 1.

2.4 Accession Sources for MQ-1 Predator and MQ-9 Reaper Pilot Trainees

MQ-1 Predator pilots are drawn from three sources: (1) pilots who cross train from a manned airframe (e.g., F-16, F-15, B-2, C-130, C-117, KC-135), (2) recent pilot graduates from Undergraduate Pilot Training (UPT), and (3) nonpilot commissioned officers. The last source draws from navigators from manned airframes (e.g., C-130, KC-135) and officers in nonflying career fields (e.g., acquisitions, logistics, security forces, and engineering).

2.4.1 Experienced (Cross-Trained) Pilots. Currently, the primary accession source is rated pilots from manned airframes who have been selected to “cross train” into the Predator/Reaper career field. Operational commanders and leadership have relied upon rated pilots because of their flying knowledge and skills. Pilots from this selection pool come from various airframes (e.g., fighter, bomber, tanker, transport, and surveillance), are generally of the rank of captain or higher, and tend to be in their late 20s to mid 30s in age. In general, they have a significant amount of experience in military flying and operating as a USAF pilot and officer. Leadership initially reported that cross-trained pilots would only serve a temporary RPA assignment of 3 to 4 yr. However, due to the continual surge and reliance upon RPA operations in theaters of conflict, only a limited number of RPA pilots who cross-trained have returned to flying manned aircraft.

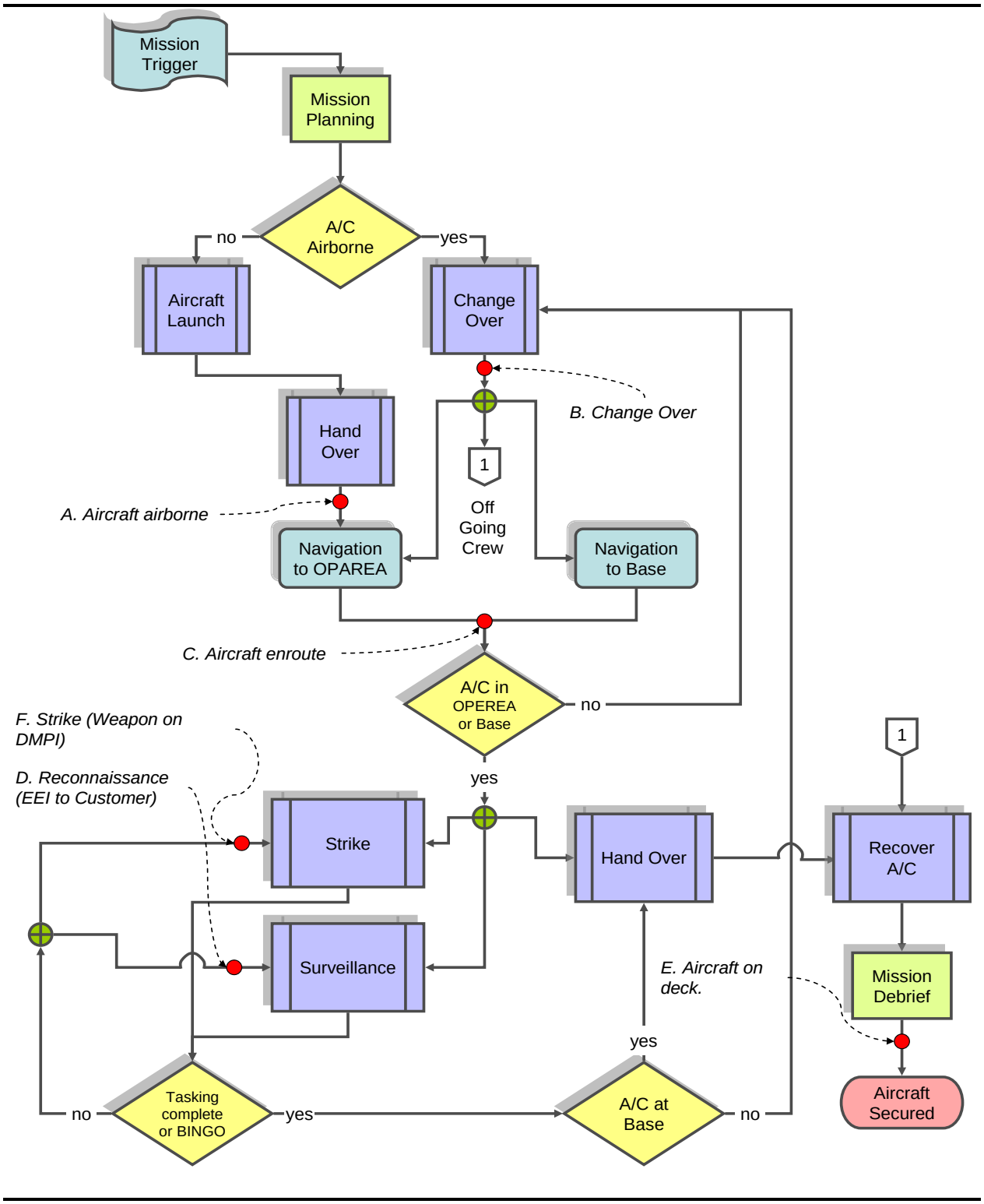

Figure 2. MQ-1 Predator Pilot Workflow (adapted from Nagy et al., p. 1)

2.4.2 Inexperienced Pilots (Recently Graduated UPT Students). The second source includes newly graduated UPT students. UPT graduates have 52 wk of pilot training in a manned aircraft and have passed rated pilot requirements. They are officially recognized as USAF rated pilots at the end of UPT training. Normally, a UPT graduate would be selected for a manned airframe and continue on to advanced training in a manned aircraft. Pilots from this selection pool are, in general, the rank of lieutenant and tend to be in their middle to late 20s in age with minimal experience operating as a USAF pilot and officer. USAF leadership has decided to assign a number of UPT graduates each year to the RPA platform. Similar to experienced cross-trained pilots, their RPA assignments are considered temporary and expected not to exceed 3 to 4 yr. They are eligible for assignment to a manned airframe once they complete their tour in RPA operations. However, similar to experienced pilots who cross-trained from manned airframes, the demand for experienced RPA pilots to meet the continual growth in RPA operations reduces the likelihood they will be able to return to flying a manned aircraft.

2.4.3 Nonpilot Officers. The third accession source was developed toward the end of 2008 and draws from USAF nonpilot commissioned officers from (a) experienced and rated USAF navigators (e.g., panel navigator, electronic warfare officer, weapons system officer, or air battle manager) and (b) nonflying career fields (e.g., acquisitions, logistics, security forces, engineering, services, space, and missile duty). The third accession source was developed to alleviate the demand of taking highly qualified pilots (experienced and inexperienced) and having to retrain them to fly an RPA aircraft. The third accession source was also developed to meet the critical shortage of RPA pilots due to the increasing demand for RPA operations in theaters of conflict. The goal of training nonpilot officers is to alleviate the burden of rated pilots from manned airframes from having to fill the current shortage in qualified RPA pilots. Non-RPA pilot officers are generally newly commissioned lieutenants straight out of college (e.g., USAF Academy) or experienced USAF captains looking for a career change and an opportunity to participate in “tip of the spear” RPA ISR and combat-related operations.

2.5 Training Pipeline for MQ-1 Predator Pilots

The Air Education and Training Command (AETC) developed a formal training pipeline for RPA pilot training candidates. Training consists of several phases, as displayed in Figure 3. Nonpilot officer trainees enter the RPA pilot training program earlier than rated pilot trainees (i.e., experienced pilots cross training from a manned airframe and inexperienced pilots from UPT). Nonpilot RPA pilot trainees attend Initial Flight Training (IFT) for 2 mo where they acquire fundamental pilot skills. The goal is for the nonpilot trainees to learn the fundamentals of flying and aerodynamic principles, become familiar with aircraft instruments, complete a solo flight as a pilot in a manned airframe, gain knowledge and confidence as a pilot in general, as well as obtain a standard private pilot’s license recognized by the Federal Aviation Administration (FAA). The nonpilot trainees complete several hours of training during this phase, to include dual flying, cross-country flying, night flying, simulated instrument flying, and solo flying time.

Once the nonpilot RPA pilot trainees complete this phase of training, they join RPA pilot applicants who have just completed UPT or who are cross training from a manned airframe. All RPA pilot applicant trainees enter into a 2-mo RPA Instrument Qualification Course (IQC). The focus of IQC is to learn how to operate the MQ-1 Predator in simulator training. The academic

portion of IQC covers weather, aerodynamics, crew resource management (CRM), RPA flying fundamentals, RPA instruments, and navigation. RPA pilot trainees and SO trainees train together during this phase to accelerate the acquisition of CRM skills. Operational units requested this change to help SOs overcome "guardedness" when working with officers (Wiseman, personal communication, 2010). Currently, this coursework utilizes T-6 simulators with a planned transition to commercial, off-the-shelf FAA-certified instrument simulators.

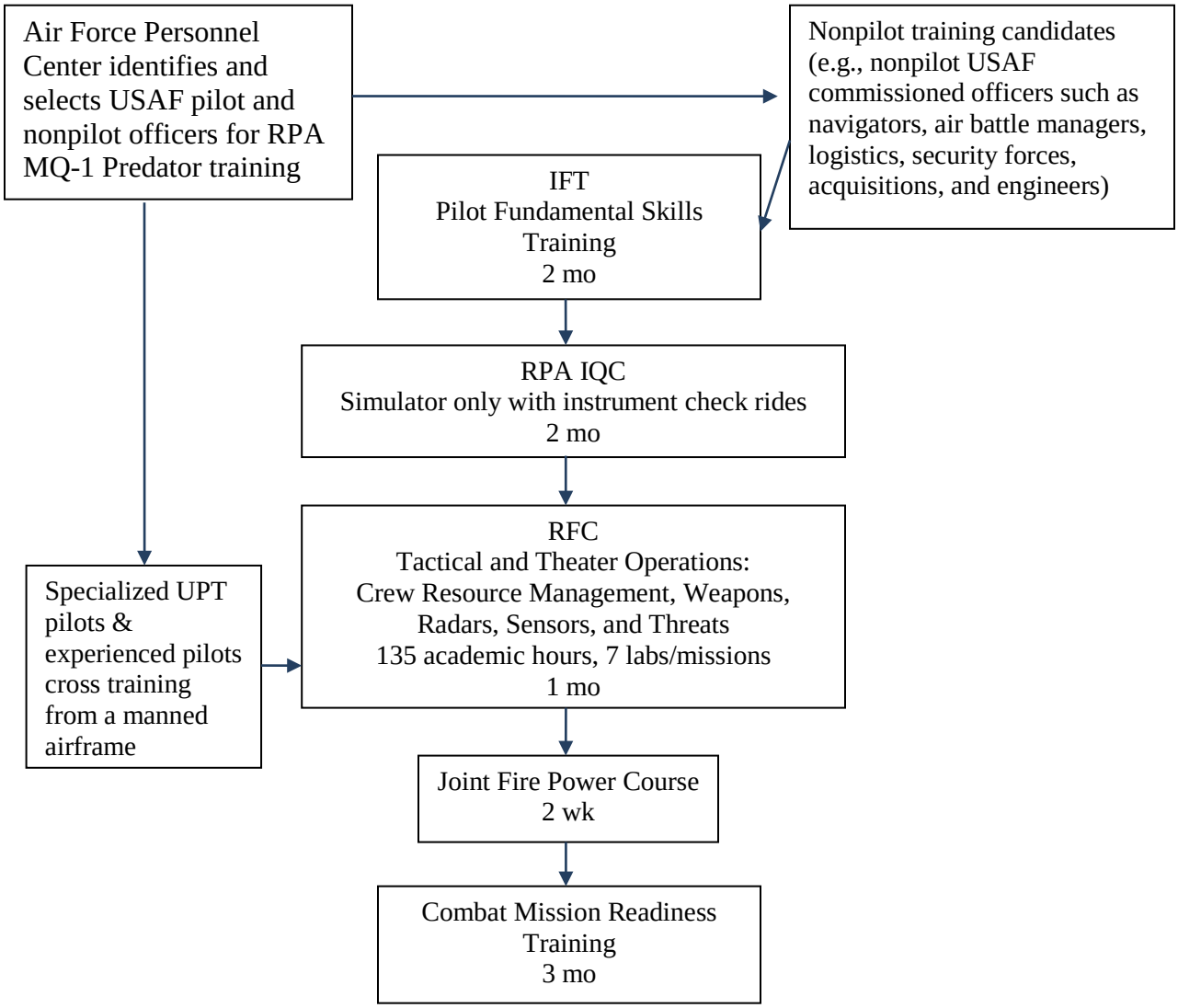

Figure 3. General Training Pipeline Training Program Flow for MQ-1 Predator Pilot Training Candidates

After completion of IQC, all RPA pilot trainees undertake 135 hr of academics and seven labs/missions in the RPA Fundamentals Course (RFC). Academic instruction includes training on tactical and theater operations, rules of engagement, operating in battle space, weapons, radars, sensors, as well as CRM. In general, the goal of RFC is to provide foundational aviation skills to meet Formal Training Unit (FTU) requirements.

Upon completion of RFC, RPA pilot trainees enter the Joint Firepower Course (JFC). The course provides instruction on concepts, doctrine, control systems, tactics, techniques, and procedures by which air and surface combat forces plan, request, coordinate, and control joint firepower among military branches on the ground, air, and sea. The course teaches pilot trainees how to coordinate the mission, pass on information, and receive orders in a joint operations environment (Wiseman, personal communication, 2010). The goal is to teach pilot trainees how to integrate RPAs into joint combat operations that involve identifying, targeting, and destroying enemy combatants and assets.

After completion of JFC, pilot trainees join their FTU. The FTU is the RPA operational Air Combat Command (ACC), Air Force Special Operations Command (AFSOC), Air National Guard, or USAF Reserve unit to which the pilot trainee is assigned to support. This training is composed of three phases and can vary according to the specific training instruction requirements of the unit. FTU training focuses on combat mission readiness and weapon-system employment. A trainee is considered c*ombat ready* when he or she is perceived as being professionally and technically proficient in supporting combat-oriented missions.

Pilots for the MQ-9 Reaper are drawn from a pool of highly experienced and qualified pilots within MQ-1 Predator squadrons. Instructors utilize a series of individually tailored tasks, instruction, and supervision specific to the squadron-training regimen for the MQ-9 Reaper. Although there is considerable overlap in the job tasks and requirements between this airframe and the MQ-1 Predator, SMEs report that piloting the MQ-9 Reaper draws more upon tactical and strategic maneuvering and flying skills (Bruzzini, personal communication, 2010). The aircraft's involvement in close air support and other precision-strike operations, particularly in urban environments, demands superior capabilities. The MQ-9 Reaper airframe flies faster, higher, and longer and has greater weapon-deployment capabilities and operations compared to that of the MQ-1 Predator. As a result, operational commanders prefer to place experienced MQ-1 Predator pilots in this role (Bruzzini, personal communication, 2010).

2.6 Research on Psychological Attributes of USAF Pilots

It is important to note, in this study, a psychological *attribute* is distinguished from *knowledge* and *skill*. The term "attribute" refers to the inherent aptitudes, traits, and motivation that must be present to acquire the level of knowledge and skills needed to successfully operate as a pilot and adapt to the unique demands of the RPA platform. The terms "knowledge" and "skill" refer to those aspects of functioning gained through various forms of experience and training.

2.6.1 Cognitive Aptitudes. Several studies have assessed the intelligence and cognitive aptitudes of USAF pilots of manned airframes (Ref 11-13). USAF pilots tend to score on the high average to superior range of intellectual functioning on verbal and visual performance based aptitudes. A meta-analysis of military pilot selection literature over the past 20 yr concluded that inherent cognitive aptitudes relevant to pilot performance include general intelligence, general verbal and quantitative abilities, dexterity, perceptual speed and information processing, reaction time, and visual-spatial abilities (Ref 14). The finding that USAF pilots have a high level of cognitive aptitude is not surprising given such aptitude is one of the strongest predictors of job performance in general (Ref 15,16), as well as pilot training (Ref 17,18). Based upon the body

of empirical findings, it stands to reason that high levels of intelligence and inherent cognitive aptitudes are critical to training and adapting to the operational demands of military flying.

However, the literature on cognitive aptitudes specific to the performance of RPA pilots is limited. A comprehensive review of the basic knowledge, skills, and abilities of RPA pilots in general (civilian and military) by Pavlas et al. (Ref 19) alluded to several cognitive attributes as key to performance, including situational awareness, vigilance, spatial analyses (i.e., ability to mentally manipulate two-dimensional objects into a three-dimensional mental image), reasoning, speed of information processing, as well as visual tracking, searching, and scanning.

The results of the review by Pavlas et al. (Ref 19) were similar to other studies that assessed the job tasks and skills required for military-specific RPAs such as the Pioneer (e.g., Ref 20,21) and Global Hawk (Nagy JE, Muse K, Eaton G, Phillips A, *U.S. Air Force Unmanned Aircraft Systems Performance Analyses: Global Hawk Pilot and Sensor Operator Front End Analysis (FEA) Report*, SURVIAC-TR-10-041, Survivability/Vulnerability Information Analysis Center, Jan 2007; available through the Defense Technical Information Center to U.S. Government agencies and their contractors only). The Pioneer is a small RPA designed primarily for short-range, low-altitude missions to provide commanders with real time ISR data on the battlefield. The Global Hawk is a long-range, high-altitude aircraft that gathers ISR data within a wide range of global areas of interest. The cognitive aptitudes stated or implied in the studies above are similar to the aptitudes that were stated directly or implied in the task analysis of MQ-1 Predator pilots by Nagy, Kalita, and Eaton (see Nagy et al., p. 1). Cognitive aptitudes that appear common to most major Predator job accomplishments included, but were not limited to, situational awareness, vigilance, spatial analyses and reasoning, speed of information processing, visual tracking, searching, and scanning, as well as complex and divided attention.

At the present time, the most comprehensive task analyses focusing on cognitive aptitudes critical to performance of MQ-1 Predator and MQ-9 Reaper pilots were completed by Bailey (Bailey M, *Predator Pilot and Sensor Operator Selection Test Batteries*, Royal Air Force Technical Report, Cranwell Royal Air Force Base, England, 2009; available by request only). The study identified several specific cognitive aptitudes as critical to performance, including perceptual reasoning and processing, short-term memory, spatial reasoning, symbolic reasoning, central information processing, psychomotor dexterity, and reaction time. Bailey reasoned that cognitive aptitudes contribute to about two-thirds of the factors associated with MQ-1 Predator pilot job training and success.

2.6.2 Personality Traits. It is important to note that cognitive aptitudes do not account for all of the factors associated with training and operational success. This gap leaves open the possibility that other factors such as personality traits and motivation are additional contributors to the performance of USAF Predator/Reaper pilots.

Several studies suggest personality traits among military pilots in manned airframes have an important role in training and job performance (Ref 22-29), aeromedical assessment (Ref 1), as well as retention (Ref 30). An extensive meta-analysis of the literature over the past 20 yr regarding military aviator selection conducted by Paullin et al. (Ref 14) reported personality traits relevant to pilot performance include conscientiousness, integrity, achievement orientation, emotional stability, resilience, openness, self-confidence, self-esteem, and risk tolerance. Such traits have been found among pilots from the USAF (Ref 31), Army (Ref 32), Navy (Ref 33), and National Aeronautics Space Association astronauts (Ref 34). Furthermore, a meta-analysis of personality data from assessment and selection programs of high-risk, high-operational

military professions that included USAF pilots reported additional personality traits relevant to performance include initiative, motivation, drive, self-discipline, dependability, and cooperation (Ref 35). Such traits are considered important to adapting to the rigors of highly demanding and dangerous conditions and job tasks.

However, the research literature regarding the personality traits of successful USAF Predator/Reaper pilots is very limited. Personality traits related to risk taking, stress tolerance, comfort working in a confined space with others, and positive social exchanges related to crew resource management regarding the performance of RPA pilots in general were alluded to by Pavlas et al. (Ref 19). The reviews of selection recommendations for Navy RPA pilots discussed the importance of hardiness (i.e., resilience to stress and adaptability) as well as positive social interpersonal exchanges and style (i.e, group warmth) as being critical to performance (Ref 20,21).

The identification of personality traits composing the "right stuff" is a controversial area. It is likely the validity of how well personality traits influence performance is, to some degree, dependent upon the type of job of a pilot. Regardless of one's view regarding personality traits that constitute the "right stuff" and are critical to job performance (Ref 26,36), personality is considered to have a key role in succeeding as a USAF pilot in highly demanding conditions (Ref 37-39), as well as considerations for occupational suitability (Ref 40,41).

2.6.3 Motivation. One particular attribute considered critical to performance, but that receives less attention, is motivation. Motivation is the inherent drive, desire, and sense of reward a pilot experiences from pursuing such a profession. Although the empirical literature on pilot motivation is limited, a recent study by Campbell, Castenada, and Pulos (Ref 38) found that motivation is a significant predictor of military training success. It is important to note the assessment of motivation is a core piece of the aviation adaptability rating and medical flight screening for all USAF pilot training candidates for manned or unmanned airframes. According to USAF aeromedical policy, pilot candidates whose motivational interest appears flawed (e.g., pursuing such a challenging occupation to win the approval of a parent) are selected out from continuing into the training pipeline (Ref 42). It is likely that specific cognitive aptitudes and personality traits essential for performing and adapting to the rigors of RPA pilot duties may reveal who has the capability, but motivational attributes may reveal who will apply, succeed, and stay in the position.

2.7 Purpose of the Study

As mentioned previously, the overarching research objective is to formulate a theoretically oriented, multidimensional profile of psychological attributes deemed critical to training and operational performance based upon the input of line operators and SMEs. SMEs such as pilots, training instructors, sensor operators, commanders, and flight surgeons are in the unique position to provide rich information about characteristics that define pilots who perform and adapt to the RPA platform. The list of attributes can then serve as a foundation of empirical investigation. Identifying attributes perceived as critical to performance can guide assessment and selection procedures for identifying commissioned officers aeromedically suitable for such a position as well as serve as an effective tool of communication between line commanders and medical personnel leadership.

3.0 METHODS

3.1 Participants

A total of 82 SMEs from two separate ACC and AFSOC active duty RPA installations participated in this study. Participants included 1 wing commander (CC), 1 vice wing CC, 8 RPA pilot squadron CCs, 6 RPA pilot squadron directors of operation (DOs), 5 RPA pilot flight CCs, 26 RPA pilots, 17 RPA SOs, 7 mission intelligence coordinators (MICs), 2 standards/evaluations RPA pilots, 6 RPA pilot training instructors, and 7 flight surgeons. All RPA operators were from MQ-1 Predator and MQ-9 Reaper squadrons. Participants had each been on station for at least 12 mo, had completed all the training requirements of their assigned role, and were considered fully qualified RPA operators. All noncommand RPA operators were randomly chosen to participate in individual and group research interviews. Due to the importance of obtaining and maximizing genuine responses, personally identifiable data were not recorded.

The purpose and methodology of the study were reviewed and granted exemption from the Wright-Patterson Air Force Base Institutional Review Board and assigned protocol number F-WR-2009-0027-E. The voluntary and fully informed consent of participates was obtained.

3.2 Procedure

The study was divided into three phases, which are described below and diagrammed in Figure 4.

3.2.1 Phase I: Subject Matter Expert Interviews. Individual, group, and multidisciplinary group interviews were conducted to gather information on perceived attributes considered critical to performance. As mentioned previously, the term “attribute” refers to the inherent cognitive aptitudes and personality traits that must be present to acquire the level of knowledge and skills needed to successfully operate as a pilot and adapt to the unique demands of the RPA platform. The interviews included a review of the unique platform of RPA operations, the stressors and job requirements associated with pilot duties, and how they were distinguished from various USAF manned aircraft operations. Discussion also entailed a review of cognitive aptitude and personality traits perceived as critical to adapting and thriving in the RPA platform. In addition to a general discussion, the SMEs were asked a series of standardized questions (see the Appendix).

3.2.1.1 Command Interviews. The wing CC and vice wing CC at an ACC installation provided separate 1-hr interviews with research team members. The vice wing CC also reviewed flight procedures and demonstrated RPA duties in a simulator to include targeting of enemy assets and combatants, employment of weapons, battle damage assessment, and crew resource management.

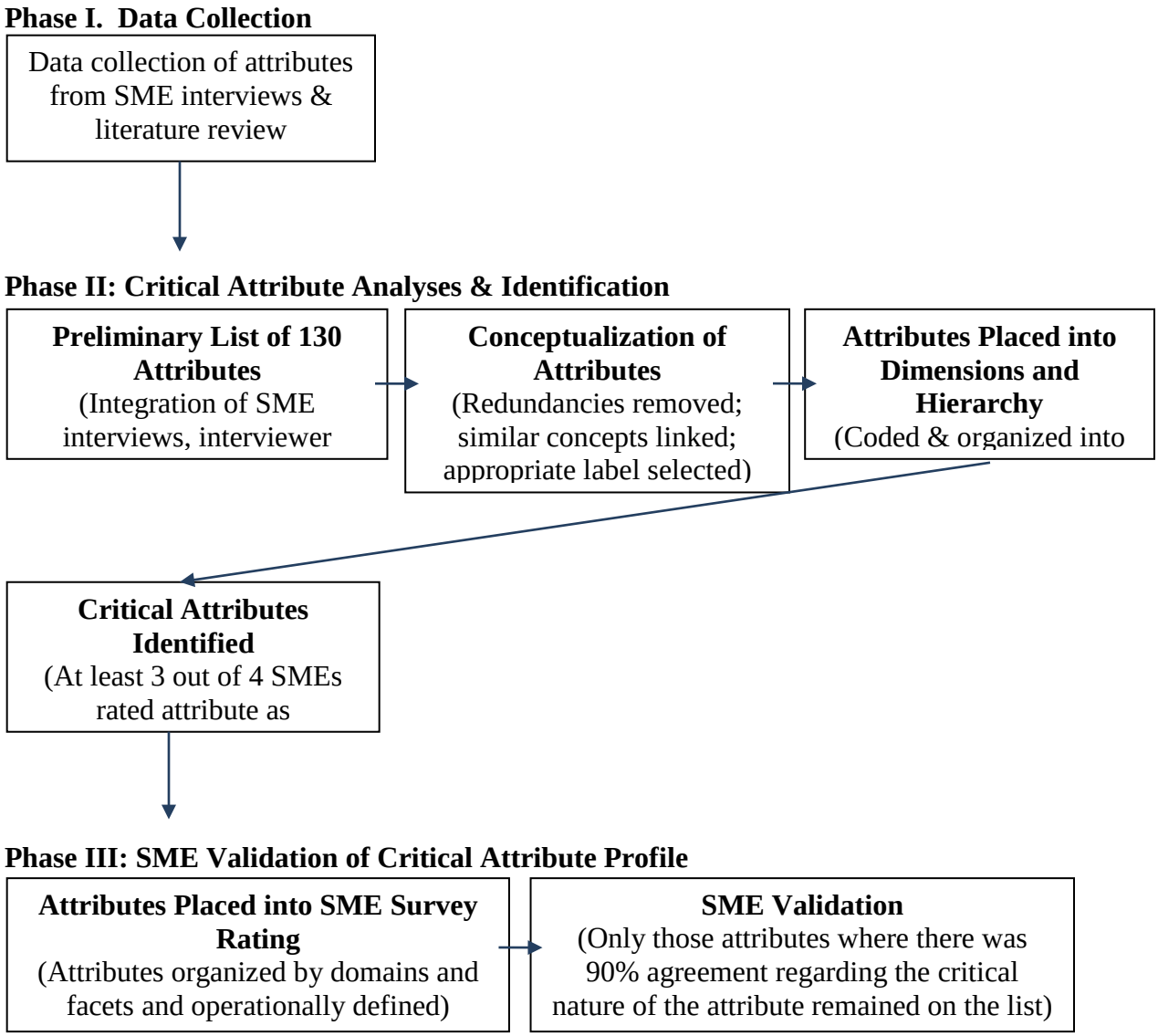

Figure 4. Workflow Regarding Qualitative Analysis of SME Interviews and Organization of Identified Attributes

The ACC squadron DOs from two MQ-1 Predator and two MQ-9 Reaper squadrons were interviewed individually. The AFSOC squadron CCs from an MQ-1 Predator squadron and an MQ-9 Reaper squadron were also interviewed individually. The ACC squadron CCs from three MQ-1 Predator squadrons and one MQ-9 Reaper squadron were also interviewed. Interviews were conducted individually and lasted between 60 and 90 min within each CC's office at the unit he or she was assigned.

3.2.1.2 Individual and Group Operator Interviews. Five ACC RPA pilots (from two MQ-1 Predator squadrons and MQ-9 Reaper squadrons) and three AFSOC RPA pilots (from an MQ-1 Predator squadron and an MQ-9 Reaper squadron) were interviewed individually. Three ACC pilots (from two MQ-1 Predator squadrons and an MQ-9 Reaper squadron) were interviewed as a group. Five ACC RPA SOs (from two MQ-1 Predator squadrons) were interviewed individually. Three RPA SOs (from an MQ-1 Predator squadron and two MQ-9 Reaper squadrons) were interviewed in a group.

3.2.1.3 Pilot Training Instructor Interviews. Researchers also received 4 hr of instruction from four ACC civilian and active duty RPA pilot instructors. Researchers observed training scenarios and discussed psychological attributes necessary for successfully responding to various training scenarios.

3.2.1.4 Multidisciplinary Group Operator Interviews. An ACC multidisciplinary group composed of four RPA squadron CCs, eight RPA pilots, five SOs, and four MICs met with research team members for a 2-hr group discussion with research team members. A total of two separate ACC multidisciplinary RPA aircrew groups composed of an MIC, three RPA SOs, and an RPA pilot met with research team members for 90-min group discussions. Finally, one AFSOC multidisciplinary RPA aircrew group composed of an MIC, an RPA SO, and an RPA pilot met with research team members for a 2-hr group discussion with research team members.

3.2.1.5 RPA Flight Surgeon Interviews. Researchers met with four flight surgeons as a group to discuss the aeromedical requirements for flying RPA aircraft and the unique impact of MQ-1 Predator and MQ-9 Reaper operations on the health of operators. The operational tempo, ergonomic design of the GCS, shift work, geographical location, as well as health status and trends resulting in readiness concerns regarding Predator/Reaper crewmembers seeking healthcare were also discussed. The group interview lasted approximately 2 hr. Researchers also met individually with three flight surgeons at each of their offices within the flight medicine clinic they were assigned. Individual interviews lasted approximately 60-90 min.

3.2.2 Phase II: Critical Attribute Analysis and Consolidation. Three behavioral science researchers performed a qualitative analysis on the content of interviews. The transcripts and memos (notes made by researchers during the interview process) from each research team member were consolidated into a list of attributes described by SMEs as important or critical to performance. The consolidated list was composed of 130 attributes (cognitive aptitudes, personality traits, and motivational components). Attributes that appeared to label the same or similar attribute were consolidated into a single attribute. For example, terms such as “smart” and “bright” might be conceptualized as “general cognitive ability.” The list was then revised again to remove redundancies and attributes with significant semantic overlap. Researchers removed those attributes that appeared to be the direct result of knowledge and skills developed from (or a product of) training (e.g., knowledge of RPA instrument controls and decision-making).

The list of attributes was theoretically organized by research team members into four domains: (a) cognitive aptitudes, (b) intrapersonal traits, (c) interpersonal traits, and (d) motivational traits (factors related to goal-achievement and areas of functioning). It is important to note that each first-level domain is composed of second-level facets, which contain distinct

attributes. For example, the cognitive domain is further organized into major neuropsychological facets (e.g., *memory*), which, in turn, contain operationally defined attributes (e.g., *spatial memory of objects*). The attributes were organized in a format that would enable comparison with tables from other studies listing critical attributes of special duty military personnel (e.g., Ref 35).

3.2.3 Phase III: SME Review and Subjective Validation of Critical Attributes. The SME validation phase consisted of two parts: an interview and questionnaire. Two researchers interviewed five RPA flight CCs, five RPA pilots, two RPA instructor pilots, two standards/evaluation RPA pilots, and a mission intelligence coordinator. The participants in Phase III were also given a questionnaire with a definition of each psychological domain, corresponding facets within each domain, and behavioral definition of attributes within each facet. Participants indicated on a 5-point Likert scale their levels of agreement from 0 (*strongly disagree)* to 5 (*strongly agree)* regarding how critical they perceived the attribute to be in training and/or operational performance.

Participants were from active duty ACC and AFSOC RPA MQ-1 Predator and MQ-9 Reaper squadrons from phase I of the study. However, it is important to note that none of the participants in phase III had participated in phase I. Interview sessions were conducted individually and lasted about 1 hr, with a 45-min interview and 15 min for completion of the questionnaire. For the purposes of protecting confidentiality, researchers did not gather specific identifying information of respondents on the questionnaire to enhance disclosure and encourage free expression of their thoughts and opinions.

Each attribute that had an average (*strongly agree*) rating of 4.5 to 5.0 was rated as "critical." Ratings that fell within the (*agree)* range of 4.0 to 4.4 were considered "important." Ratings of below 4 were considered by researchers as neither critical nor important.

4.0 RESULTS AND DISCUSSION

The research objective was to identify critical psychological attributes specific to MQ-1 Predator and MQ-9 Reaper pilots based upon the input of a large cross section of line operator SMEs as well as attributes cited in the RPA literature.

This section addresses the attributes identified by SMEs as critical or important in training and performance outcomes. It is important to note that *critical attributes* are defined as essential for training and adaptation to the platform across all major job tasks, whereas, *important attributes* play a role in long-term pilot retention and job satisfaction.

4.1 Cognitive Domain: Facets and Attributes

As mentioned previously, the cognitive domain refers to intellectual mental functions and information processing aptitudes essential to the acquisition and application of knowledge. Cognitive aptitudes implicitly stated or found in earlier studies of RPA pilot operators (see Bailey citation p. 10; Ref 19,20) and analysis of MQ-1 Predator pilot duties (see Nagy et al., p. 1) were consolidated with input from SMEs. Figure 5 displays the domain's facets, and Table 1 defines the attributes in detail.

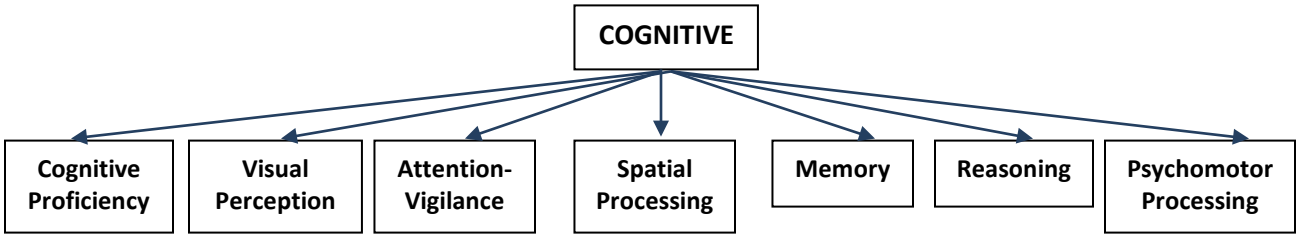

Figure 5. Cognitive Facets Considered Critical or Important for Pilot Duties

Table 1. Cognitive Domain[a]

Facet	Attribute	Type[b]
Cognitive Proficiency	General cognitive capability	✓
	Speed and accuracy of information processing	✓
Visual Perception	Visual acuity, scanning, and discrimination	✓
	Visual recognition, tracking, and analysis	✓
Attention	Vigilance to multiple sources of visual and auditory information (*situational awareness*)	✓
	Sustained and divided attention to visual and auditory information	✓
Spatial Processing	Spatial analysis and orientation	✓
	Ability to create 4-D mental representations from 2-D images (spatial reasoning and construction)	✓
Memory	Visual and auditory memory (working, immediate, and delayed)	✓
	Spatial and psychomotor memory (working, short-term, and delayed)	♦
Reasoning	"Real time" general and deductive reasoning (*problem solving*)	✓
	Task prioritization	✓
	Carefully and quickly assesses risk, likely outcomes, and potential repercussions (*forward thinking*)	✓
	Cognitive flexibility (*thinking outside the box*)	✓
Psychomotor Processing	Fine motor dexterity and reaction time	♦
	Psychomotor-spatial coordination and accuracy	♦

[a]The cognitive domain refers to intellectual mental functions and information processing aptitudes essential to the acquisition and application of knowledge. Common aspects of cognition include perception, attention, memory, comprehension, reasoning, learning, and problem-solving.
[b]"Critical" attributes are indicated by ✓ (*strongly agree*). "Important" attributes are indicated by ♦ (*agree*).

The facet of *cognitive proficiency* reflects the attributes of (a) general intelligence (verbal and performance) as well as (b) quick and accurate information processing. In general, nearly every job accomplishment of MQ-1 Predator or MQ-9 Reaper pilot duties (see Nagy et al., p. 1) requires a high level of cognitive proficiency. The finding of general cognitive proficiency as being a key attribute to performance is not surprising given that general intelligence has been identified as "central" for pilot selection (Ref 14) and performance (Ref 12,17,43) and, in general, is one of the strongest predictors of job performance (Ref 15,16). It is also consistent with the findings of the study of MQ-1 Predator pilot duties reported by Bailey (see Bailey citation p. 10).

The facet of *visual perception* represents the attributes of (a) visual acuity, scanning, and discrimination as well as (b) recognition, tracking, and analysis. SMEs highlighted these two attributes because of the numerous sources of visual data streaming from multiple video screens within the GCS and the complexity of information captured from real time video feeds.

The facet of *attention and vigilance* subsumes the attributes of (a) vigilance to multiple sources of visual and auditory information (situational awareness) as well as (b) sustained and divided attention. These two critical attributes are cited in previous RPA studies (see Bailey citation p. 10; Ref 20) and can be easily inferred from an in-depth front-end task analysis of pilot duties (see Nagy et al., p. 1). In terms of attention, Predator/Reaper pilots must also be able to sustain and divide their attention over long periods of monotony, as well as unpredictable moments of urgency to effectively respond to task requirements. SMEs repeatedly emphasized throughout interviews that "*vigilance*" to constantly updated data from multiple sources within a complex human-machine computer-based interface system places extraordinary cognitive demands upon the Predator/Reaper pilot.

The facet of *spatial processing* reflects the attributes of (a) spatial analysis and orientation as well as (b) the ability to construct three-dimensional mental representations from two-dimensional imagery. Spatial processing was repeatedly emphasized as critical for maneuvering the aircraft and performing most ISR and weapon-deployment job tasks by SMEs. This finding is consistent with a previous study on Predator/Reaper pilot duties and task requirements (see Bailey citation p. 10). For example, the ability to anticipate the position of other aircraft, ground forces, and specific targets of interest in spatial relationship to each other is essential to pilot duties (see Nagy et al., p. 1).

The facet of *memory* reflects the attributes of v*isual and auditory memory* (working, immediate, and delayed). It was reported that such abilities are critical to performance given the large amount of information from multiple sources that needs to be continuously processed and managed. Although RPA pilots use memory aids (e.g., a dry erase board, notebooks), SMEs reported such aids were inadequate for anyone who had difficulties encoding, storing, or retrieving information from visual or auditory memory. The perception among SMEs that a high level of memory aptitudes is critical to performance is consistent with the results of a previous study by Bailey (see Bailey citation p. 10) and could be easily inferred from the in-depth job task analysis by Nagy Kalita, and Eaton (see Nagy et al., p. 1).

The facet of *reasoning* reflects the attributes of inductive and deductive reasoning and processing speed. Such attributes were reported to be critical to prioritizing tasks, "real time" problem solving, and forward thinking for mission planning and managing urgent situations. Reasoning abilities are reported to play an important function in a significant percentage of strategic Predator/Reaper job tasks (see Bailey citation p. 10) and in a wide range of functions associated with RPA pilot duties in general (see Nagy et al., p. 1; Ref 19,20). Quick and accurate

inductive and deductive reasoning abilities are also considered critical to USAF special duty personnel in high-risk, high-demand positions (Ref 35).

The facet of *psychomotor processing* reflects the attributes of psychomotor coordination and speed. Due to the automated process of most RPA functions, especially during routine and uneventful ISR missions, the cognitive aptitude of psychomotor processing (namely, dexterity and coordination) was not considered critical, but important. However, the role of psychomotor skills was considered critical to manual flying that occurred during various events (e.g., diverting an aircraft due to inclement weather or higher priority tasks, maneuvering the aircraft into a tactical position for weapon deployment, or adjusting the flight path of an aircraft to optimize data gathering for surveillance and reconnaissance). Generally, the evolving automation of the platform suggests a greater emphasis on higher level information processing aptitudes versus psychomotor abilities (Ref 9,10,21). Nonetheless, psychomotor processing skills were considered an important attribute to performance among SMEs and consistent with the results of an earlier study of Predator/Reaper pilot performance (see Bailey citation p. 10).

Overall, SMEs inferred from the nature of pilot duties that a high level of general cognitive ability and effective intelligence have a considerable role in successful performance. According to SMEs, it is essential that RPA pilot trainees (and incumbents) do not have a history of (or currently struggle with) problems with visual perception, attention, spatial processing, reasoning, memory, psychomotor processing, as well as general speed and accuracy of information processing (i.e., cognitive proficiency). SMEs reported subtle deficits in these areas elevate the risk of performance-related problems, especially in time-sensitive and high-precision job tasks. SMEs also reported pilots who had difficulties processing the complex amount of information within a time-sensitive period appeared to struggle with channelized attention, task prioritization, situational awareness, and task saturation. The importance of such cognitive attributes identified by SMEs was also key to discussions on selection in earlier studies of RPA pilots (Ref 21; see Bailey citation p. 10). The importance of cognitive functioning is also easily inferred from the results of a comprehensive front end task analysis of RPA Predator pilot duties (see Nagy et al., p. 1) and recently published taxonomy of knowledge, skills, and attitudes of RPA operators in general (Ref 19).

The results of this study regarding cognitive functioning indicate that screening for a history of illnesses (e.g., bacterial meningitis), physical injuries (e.g., closed head trauma), and developmental problems (e.g., learning disorder, attention deficit disorder) affecting a person's cognitive disposition is critical and should occur prior to any pilot training applicant being assigned to RPA pilot duties (Ref 42,44). If a history of cognitive difficulties is discovered, it is essential a pilot training candidate (or rated incumbent) obtain an aeromedical waiver from AETC before entering the training pipeline. The importance of cognitive functioning is increasingly important as efforts to move to more advanced RPA airframes and multiple aircraft control systems become apparent. The increased responsibility of managing multiple RPAs simultaneously heightens the cognitive workload and demands of this position. Furthermore, the condensed period of training necessitates pilot training candidates are free from any cognitive deficits or difficulties that interfere with the timely acquisition of skills.

It is also important to note many MQ-1 Predator and MQ-9 Reaper squadrons are engaged in demanding shift work that can lead to mental fatigue (Ref 45-47), affecting cognitive performance. As a result, it is particularly important for a pilot training candidate or incumbent to have cognitive stamina, that is, the ability to sustain a heightened level of cognitive performance over lengthy periods of time (e.g., 8 to 12 hr) and over different periods of shift

work. The issue of shift work and operational tempo may be corrected in the near future when the manning shortage in trained RPA pilots is reduced and the demands for RPA operations decrease.

4.2 Intrapersonal Domain: Facets and Attributes

The intrapersonal domain of functioning refers to personality traits that are internal to the person (*intra or* "within" versus *inter* or "between" people). Such traits represent an array of noncognitive attributes (i.e., personality traits) that affect performance and adaptation to various environmental demands. The facets of the intrapersonal domain are shown in Figure 6, with further detail provided in Table 2.

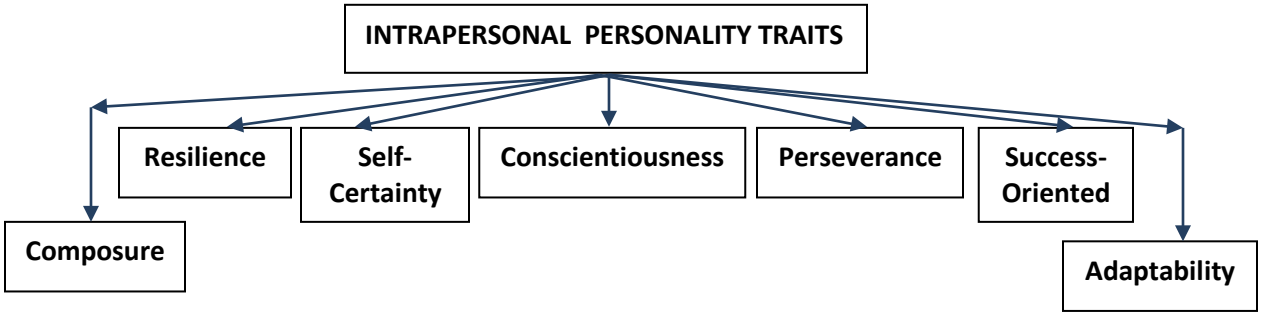

Figure 6. Intrapersonal Facets Considered Critical or Important for Pilot Duties

The facet of *emotional composure* reflects the attribute of remaining calm and composed under pressure. Self-control was perceived by SMEs as essential for maintaining focus on the mission across all major job tasks and accomplishments and especially important to crew resource management. SMEs also noted the ability to control emotions during urgent situations (e.g., aerial strikes or reconnaissance of enemy combatants, interaction with ground forces, targeting of high-value assets) as especially critical. The attribute of emotional composure is also considered critical to the selection of successful military pilots (Ref 14) and high-demand, high-operational military personnel (Ref 35).

The facet of *resilience* reflects the attribute of hardiness in response to widely disparate situations—high stress versus tiresome monotony. Resilience is the ability to reliably sustain emotional composure combined with an optimistic attitude. Several SMEs described personal experiences in reconnaissance and precision-strike operations they considered difficult and highly stressful, where having a high level of resilience was critical to performance. Resilience (e.g., low level of neuroticism) is also considered critical when selecting high-demand, high-operational military personnel (Ref 35) and successful military pilots (Ref 14,38).

Table 2. Intrapersonal Domain[a]

Facet	Attribute	Type[b]
Emotional Composure	Remains calm, composed, and in control of behavior and emotions under stress (e.g., does not readily show or experience fear, sadness, or irritability)	✓
Resilience	Emotional stamina and hardiness in response to monotony, unpredictable moments of high stress, and high pressure situations	✓
Self-Certainty	Clear sense of self and self-confidence across routine and high pressure tasks and situations	✓
	Clear sense of identity and role as an officer and war fighter	✓
Conscientiousness	Deliberate, methodical, and highly organized	♦
	Highly dependable, reliable, and self-disciplined	✓
Perseverance	Completes tasks despite boredom, hardship, and potential distractions	✓
	Sustains a high level of effort over long periods of time despite hardships	✓
Success Oriented	Self-motivated and driven to succeed and achieve	♦
	Seeks new and innovative ways to improve performance	♦
	Strong interest in mastering challenging tasks and in emerging computer-based technology	✓
Decisiveness	Makes decisions in real time, under pressure, and within operational deadlines	✓
	Operationally patient in making the right decision and committing to a course of action	✓
Adaptability	Effectively sizes up and deals with problematic situations and environmental demands	✓
	Generally flexible, realistic, and effectively understands problematic stressors in occupational and personal settings	✓
	Finds good ways of managing and resolving stressors and conflicts	✓
	Effective compartmentalization of personal stress from occupational duties	✓

[a]The intrapersonal domain refers to an array of noncognitive capabilities and traits that affect performance. Common elements related to performance include general ability to identify and regulate emotions, positive self-regard, self-confidence, self-discipline, self-esteem, hardiness, impulse control, self-direction, general emotional disposition, and ability to realize and act upon one's potentials.

[b]"Critical" attributes are indicated by ✓ (*strongly agree*). "Important" attributes are indicated by ♦ (*agree).*

The facet of *self-certainty* reflects the attributes of having a clear sense of self and self-confidence across job tasks in both routine and high-pressure situations. In particular, RPA pilot instructors reported that training candidates who demonstrated high levels of self-certainty and self-confidence appeared to acquire skills in a more timely fashion and perform at higher levels. It is likely that a strong sense of self-certainty among successful RPA pilots is a combination of an existing trait fostered by training and an interpersonally supportive environment.

The facet of *conscientiousness* reflects the attributes of being (a) deliberate, methodical, and highly organized as well as (b) highly dependable, reliable, and self-disciplined. Conscientiousness is critical given the high attention to detail and overall nature of the responsibilities of RPA pilots. SMEs viewed dependability, reliability, and being self-disciplined as critical but considered being deliberate, methodical, and highly organized as important. It is possible that the propensity to demonstrate a methodical, deliberate, and highly organized approach to tasks was not seen as "critical" given the automated nature of many RPA pilot functions. However, in general, conscientiousness (particular facets, especially) tends to be significantly higher in military pilots than the normal population (Ref 1) and is a key predictor of job performance (Ref 15) and selection of military pilots (Ref 14), as well as high-demand, high-risk military personnel (Ref 35).

The facet of *perseverance* reflects the attributes of (a) completing tasks despite boredom, hardship, and potential distractions as well as (b) having the capacity to sustain high levels of effort over long periods. This notable attribute was reported as critical by SMEs, especially during long-endurance, high-risk missions. This attribute was also perceived by SMEs as directly connected to sustaining vigilance and situational awareness to the continual input of visual and auditory data, even during routine, highly automated reconnaissance missions.

The facet of being *success-oriented* reflects the attributes of being (a) self-motivated and driven to succeed, (b) inclined to seek new and innovative ways to improve performance, and (c) able to master challenging tasks and emerging computer-based technology. These attributes were seen as important but not critical. Strong interest in mastering new technology was rated more strongly than its companion attributes. The attributes of being self-motivated and driven to succeed as well as seeking innovative ways to improve performance were seen as critical to retention and career progression, and not necessarily overall performance across job tasks and duties.

The facet of *decisiveness* reflects the attributes of (a) making decisions in real time, under pressure, within operational deadlines, and (b) remaining operationally patient in making the right decision and committing to a course of action. The facet of decisiveness is likely influenced by both training and experience along with aspects of self-certainty and confidence. Regardless, decisiveness was reported as a key attribute of performance across most major job accomplishments associated with high-stress aerial strikes, as well as mundane ISR tasks.

The facet of *adaptability* was reflected by attributes that were difficult to define and included (a) sizing up and dealing effectively with problematic situations and environmental demands; (b) being flexible, realistic, and effective with understanding stressors in occupational and personal settings; (c) managing and resolving stressors and conflicts; and (d) effectively compartmentalizing personal stress from occupational duties. SMEs repeatedly reported compartmentalization as a highly desirable ability that allow pilots to be able to "deploy" at work and return to their domestic lives at home on a daily basis without the emotional rigors of work creating relationship difficulties in their domestic life.

In general, the input of operational SMEs indicates that intrapersonal traits play an important role in job performance, as well as health and well-being; therefore, this domain is critical. The intense pressures of job performance and the psychological impact of ISR and aerial strike missions create chronic stressors that affect performance, health, and well-being and potentially impact personal relationships. The impact of personality traits on the performance of USAF pilots in manned (Ref 37,40) as well as unmanned (Ref 21) airframes was brought to attention in the professional literature over a decade ago. The interest in personality on

performance has continued with recent studies demonstrating a link to pilot training success (e.g., Ref 38) as well as general suitability for pilot duties (Ref 41). Many of the personality traits listed above (e.g., conscientiousness, emotional composure, adaptability) are considered key to the selection of military personnel in high-demand, high-operational positions (Ref 35).

SME input has helped to shed light on intrapersonal personality traits that are adapative, as well as likely incompatible with RPA pilot duties. A person who is overly self-conscious, lacking in self-confidence, and/or has a significant history of emotional difficulties is likely not well-suited for the occupational demands of RPA operations (Ref 44). Areas of concern include (a) behavioral impulsivity and problems controlling anxiety, depression, anger, and other negative emotional states; (b) a repeated pattern of failure under pressure and difficulty; as well as (c) lack of perseverance and overly negative attitude toward adversity. It was repeatedly emphasized by SMEs that an individual with any of the aforementioned difficulties will likely have adjustment-related problems with adapting to the rigors of the position. It is also noted that any person with a history of emotional or behavioral difficulties (e.g., depression, anxiety, and adjustment disorder) as outlined in AFI 48-123 section 6H (Unmanned Aircraft System Medical Requirements) (Ref 42) must have an aeromedical waiver prior to being considered for RPA pilot duties.

4.3 Interpersonal Domain: Facets and Attributes

The interpersonal domain, shown in Figure 7, refers to those traits and qualities affecting performance in a variety of social exchanges and conditions. Interpersonal qualities help a person to navigate and respond to a wide range of social situations and demands. Common aspects of interpersonal functioning affecting performance include the ability to understand others and interact with them, ability to communicate effectively under varied conditions and modalities, and ability to relate to others in a way that cultivates positive relations (see Table 3).

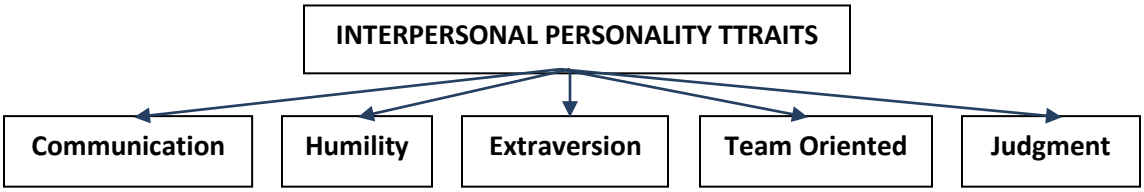

Figure 7. Interpersonal Facets Considered Critical or Important to Pilot Duties

Table 3. Interpersonal Domain[a]

Facet	Attribute	Type[b]
Humility	Ability to recognize the need and willingness to seek help from leadership and others	✓
Extraversion	Open and accepting of critical feedback from peers, subordinates, leadership	✓
	Shares credit for success, accepts responsibility for mistakes	✓
	Receptive and approachable	♦
	Socially engaging and outgoing; fosters positive relations	♦
	Understands and effectively responds to emotional states of others	♦
Judgment	Comfortable with different personality styles and working under constrained and varied conditions	✓
	Situationally aware; responsive; effectively resolves/diffuses interpersonal conflict	♦
	Social behavior at work and off-base settings demonstrates prudence for national security and the integrity of military operations	✓
Team Oriented	Comfortable leading, working with enlisted personnel as a team	✓
	Competitive disposition but does not jeopardize group and mission goals for individual goals	✓
	Interest in teaching others and promoting morale	♦
	Trusting of other aircrew and military personnel	✓

[a]The interpersonal domain refers to those traits and qualities affecting performance in various social exchanges and conditions. Common aspects of interpersonal functioning affecting performance include ability to understand others and interact with others, ability to communicate effectively under varied conditions and modalities, ability to relate to others in a way that cultivates positive relations.
b"Critical" attributes are indicated by ✓ (*strongly agree*). "Important" attributes are indicated by ♦ (*agree).*

The facet of *humility* reflects the attributes regarding (a) willingness to seek help from leadership, (b) ability to share credit for success/mistakes, and (c) acceptance of feedback from superiors and subordinates. The aspect of being receptive and approachable is perceived as an important interpersonal trait. It was reported by most SMEs that although there are times an RPA pilot engaged in close air support must demonstrate decisiveness and assertiveness, it is key that such attributes are balanced in a way that allows the pilot to be receptive and approachable by others, especially the SO.

The facet of *extraversion* reflects the attributes of (a) an outgoing disposition that fosters positive relations, (b) attentiveness and effective responsiveness to the emotional states of others, (c) situational awareness and effective resolution of interpersonal conflict, as well as (d) ability to be comfortable working with different personality styles under constrained conditions. SMEs reported that being comfortable working with different personalities was critical to performance. It was repeatedly reported by SMEs that a pilot training applicant who has a high level of interpersonal discomfort working in a confined space with rotating crewmembers will likely

have performance difficulties. Although they did not report the interpersonal qualities of an outgoing disposition, emotional empathy, and situationally suave disposition during interpersonal conflict to be critical to performance, they reported such qualities as factors that defined those who were high performers with high levels of job satisfaction. The trait of extraversion has been found to influence military pilot training success (Ref 37,38) and general aeromedical suitability (Ref 41).

The facet of *judgment* reflects the attribute of social behavior (at work and off-base settings) that demonstrates prudence for national security and the integrity of military operations. This facet is clearly reflective of a level of prudence that would be expected of all USAF officers. However, the classified nature of operations that are engaged in on a daily basis is perceived by SMEs to accentuate the importance of demonstrating prudence above and beyond the current level of expectations, in general, when compared with noncombatant USAF officers.

The facet of being *team oriented* reflects the attributes of (a) a high level of comfort leading and working with enlisted personnel in a small team, (b) a competitive disposition that does not jeopardize group and mission goals for individual goals, and (c) trusting of other aircrew and military personnel. These attributes and behavioral interactions were described as critical to the "team" nature of RPA crew resource management and critical to effective interactions with the SO and MIC. Although having a strong interest in teaching others and promoting morale was described as important, it was not critical to performance. Such character traits were associated more with those considered to be "high performers" and well-liked by others.

Overall, the interpersonal traits described above refer to those general aspects of social behavior and interactions perceived by SMEs as highly related to performance. It makes sense that although there may be a wide range of different personality styles, there is a core set of interpersonal traits considered key to performance. The work tasks and environment are such that RPA pilots need to have a mix of social complements, for example, being competitive yet cooperative and being able to take a leadership role while maintaining a sense of humility.

The finding of interpersonal traits as being critical to Predator/Reaper pilot performance has important aeromedical implications (Ref 44). Although a person may appear to possess the cognitive aptitude, if he or she has significant interpersonal deficits or social interactions that interfere with crew resource management, he or she could reasonably be disqualified from RPA duties in accordance with AFI 48-123 (Ref 42). The RPA environment is highly interpersonal, and having a level of interpersonal effectiveness is necessary for successful training and operational performance. A person who is highly introverted, and/or has a significant history of interpersonal difficulties, is likely not well-suited for the occupational demands of RPA operations. Areas of concern include (a) schizoid or schizotypal traits and other odd traits that lead to adaptation difficulties, (b) repeated pattern of social isolation and withdrawal or social impulsivity and aggressiveness, as well as (c) chronic behavioral habits or traits that interfere with effective social exchanges. It was repeatedly emphasized by SMEs that an individual with any of the aforementioned difficulties will likely have performance and adjustment-related difficulties. According to aeromedical standards, any person with a history of perceived traits that are considered maladaptive to performance as outlined in AFI 48-123 section 6H (Unmanned Aircraft Systems Medical Requirements) (Ref 42) must have an aeromedical waiver prior to being considered for RPA pilot duties.

4.4 Motivation Domain: Facets and Attributes

The motivation domain, shown in Figure 8, refers to personal beliefs, intrinsic factors, and internal values and interests that activate goal achievement and ultimately affect performance. Motivation is a key aspect of performance as it relates to self-directed actions and efforts and is key to a high level of performance. Attributes that were coded into the moral domain were separated according to moral and occupational facets (see Table 4).

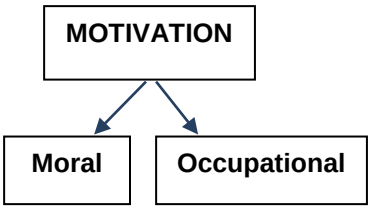

Figure 8. Motivational Facets Considered Critical or Important Pilot Duties

Table 4. Motivational Domain[a]

Facet	Attribute	Type[b]
Moral	Motivated to save lives and protect U.S. and coalition forces	✓
	Personal beliefs (spiritual, religious) support combat operations	♦
Occupational	Possesses a sense of duty as an officer and warfighter	✓
	Realistically understands and appreciates RPA platform	♦
	Strong interest in advanced and emerging avionic RPA technology	♦
	Enjoys duties of the position and contribution to daily operations in theater	♦
	Strong interest in advancing national interests and mission objectives	♦

[a]The motivation domain refers to personal beliefs and intrinsic (internal rewards) factors that affect performance. Common elements of motivation include interest in the RPA mission and duties and advanced computer technology.
b"Critical" attributes are indicated by ✓ (*strongly agree*). "Important" attributes are indicated by ♦ (*agree*).

The facet of *moral motivation* refers to the desire to save lives and protect U.S. and coalition forces. The desire to save lives is distinguished from the interest in killing enemy combatants and destroying targets. SMEs reported the desire to save lives was associated with performers who exercised judgment and restraint to ensure identified targets were, in fact, effectively identified without a rush to judgment and deploying weapons. This attribute was also associated with those who reported to have high levels of job satisfaction. It is notable, though, that SMEs brought up the importance of a personal belief system, as it distinguished high performers as well as those who had difficulty with deploying weapons. SMEs reported those whose belief system appeared incompatible with deploying weapons often struggled with their role in precision-strike operations. It is apparent, from SME input, that an incompatible belief system associated with the deployment of weapons negatively affects performance.

The facet of occupational motivation refers to the attributes of (a) possessing a sense of duty as an officer and warfighter, (b) understanding and appreciating the Predator/Reaper platform, (c) having an interest in advanced and emerging avionic RPA technology, (c) having an inherent interest in the duties of the position, and (d) having a strong interest in advancing national interests and mission objectives. The sense of duty as an officer and warfighter was considered critical, not only in terms of effective crew resource management but as it relates to the level of leadership required of officers, in general. However, the attributes related to enjoying the duties of the position and advancing national interests were not seen as critical, but important. That is, it was not necessary for performing job tasks but was essential to job satisfaction and long-term retention, which are a key part of sustaining an experienced work force.

The attributes of motivation are perceived by SMEs to serve as enhancements that not only promote performance but job satisfaction and longevity as well. The finding that an incompatible belief system and interest in Predator/Reaper duties have a key role in performance has implications in the assessment of aeromedical adaptability for RPA pilots by USAF flight surgeons. If there are significant concerns regarding motivational issues that are perceived to affect performance, an RPA pilot candidate or incumbent may be disqualified from his or her pilots duties in accordance with AFI 48-123 (Ref 42). Although reasons for pursuing RPA pilot training can vary, it stands to reason that motivation is critical to performance. For instance, an empirical study assessing the relationship of performance among pilot trainees revealed intrinsic and extrinsic aspects of motivation to be a significant predictor of performance (Ref 48).

5.0 ASSESSMENT/SELECTION OF TRAINING CANDIDATES

Given the USAF's request to expand MQ-1 Predator and MQ-9 Reaper operations, over 100 individuals each year will need to complete the RPA pilot training pipeline. Consequently, there is strong interest in selecting USAF commissioned officers from nonpilot duty positions at large (e.g., navigators, air battle managers, acquisitions, logistics, security forces, engineering) for RPA pilot duties. The potentially large pool of commissioned officers requires an assessment and selection program based on a multimodal approach that identifies officers most likely to adapt to the rigorous demands of the Predator/Reaper platforms. An effective and efficient selection program is less costly than managing the disruption to operational capabilities from USAF officers who fail to adapt and thrive in the RPA community. SMEs indicated that a selection program needs a "whole person approach" that incorporates the myriad of attributes needed for training and operational performance.

5.1 Aeromedical Screening

The ability to accurately predict the success individuals will have in a training program or to determine the level of attainment they will reach can be extremely difficult. Nonetheless, in regards to RPA pilot duties, the ability to use instruments to "screen out" candidates is especially favorable. The first step in any selection process is to s*elect out* applicants who do not meet the aeromedical standards or waiver criteria as outlined in AFI 48-123 section 6H (Unmanned Aerial Systems Standards) (Ref 42). A prescreening questionnaire that identifies candidates with aeromedically disqualifying conditions can serve as a first step in an efficient and cost-effective program to select out applicants.

Evidence of cognitive, emotional, behavioral, or interpersonal difficulties disqualifies a candidate until the candidate receives an aeromedical evaluation and waiver. The screening process may include a review of medical records, completion of background questionnaires, and psychological testing. The process may coincide with the medical flight screening of pilot training candidates selected for manned airframes. The screening process will help to ensure applicants meet RPA Flying Class IIU aeromedical standards as outlined in AFI 48-123 (Ref 42) and are free of cognitive, emotional, or behavioral difficulties that are likely to negatively affect performance and/or adaptation to RPA operations.

5.2 Computer-Based Psychological Testing

To assist in the identification of those individuals at risk of problems, the administration of objective psychological testing can be very beneficial. The recognition of applicants with significant psychological problems, deficits, or incompatible character traits (e.g., schizoid, avoidant, schizotypal traits) allows removal from the selection pool without having to conduct a more time-intensive and costly interview.

However, the selection of tests depends to some extent on the resources available for assessing personnel, the amount of time an evaluator has to assess each applicant, as well as the format of the evaluation setting (group vs. individual).

As mentioned previously, general cognitive ability must be assessed when evaluating prospective applicants for Predator/Reaper pilot training. Effective intelligence and general cognitive ability are excellent predictors of job performance because of their direct impact on the acquisition of job knowledge. Scores from the Air Force Officer Qualifying Test (AFOQT) may be obtained to identify those who are in the upper echelon (e.g., upper 10%) of cognitive functioning of USAF commissioned officers. The AFOQT is currently used to determine whether individuals have a certain level of intellectual ability of sufficient strength to pursue aviation and aircrew platforms. However, the AFOQT may not measure visual-performance and spatial-based aptitudes as well as desired. If intellectual testing is used, visual-spatial and performance-based measures are likely key to the selection of high-performing pilot training candidates. Because the RPA pilot career field is in its infancy, there are minimal data to support or indicate which assessment instruments are the most appropriate. Regardless of the instrument chosen, it is essential the evaluating clinician use measures that are empirically validated, culturally unbiased, and supported by research.

It would also be helpful to acquire objective psychological testing that assesses both the presence of pathology as well as the normal dimensions of personality. The use of objective testing instruments in the assessment of pilot training candidates is crucial for identifying aspects of a candidate's psychological disposition that are diagnostic of emotional or behavioral difficulties and that may impair a candidate's ability to adapt to training and operational demands of Predator/Reaper pilot duties. Regardless of the measures used above, assessing the attributes of conscientiousness, neuroticism, extraversion, and concsientousness has been demonstrated to correlate with pilot training success (Ref 37,38) as well as general job performance (Ref 36) and may improve the incremental validity of selection decisions when combined with measures of general intellectual functioning and cognitive ability (Ref 16).

5.3 Structured Aeromedical Clinical-Occupational Interview

Psychological interviews for the Predator/Reaper pilot occupation can be either structured or unstructured. Unstructured interviews have no specific questions, information gathering procedures, or objective scoring. The evaluator's subjective impressions and conclusions regarding the fitness of the candidate may be informative but may also be less reliable than a structured interview (e.g., another evaluator may reach a different conclusion). Structured clinical interviews, in contrast, present standardized questions based on a job analysis and, therefore, have direct bearing on job function. Although structured interviews are more costly to construct and use than unstructured interviews, they are also significantly more valid than unstructured counterparts (Ref 16). A structured interview, at minimum, should address the domains and corresponding attributes that SMEs have identified as critical and important in this study. Interviews, in addition to standardized psychological testing, are commonplace for USAF commissioned officers entering into sensitive positions or training (e.g., survival school, sniper training, or basic military instructor training).

As noted previously, even resilient personnel are likely to face a series of life stressors or a clustering of problems at some point during their careers that lead to a moderate to severe impact on their occupational functioning. What appears to be most important according to SMEs is the pilot's ability to respond to or effectively manage these events. To identify aeromedically qualified candidates it is important to look at the presence of life stressors and events that may distract an individual from completing training or adequately adapting to the unique aspects of the RPA platform. It is important to bear in mind the timing and number of significant life stressors or other transient problems may be a cause of concern due to the impact on a person's psychological disposition. A thorough interview should address the potential impact the frequency and chronicity of such stressors will have on the candidate's ability to effectively complete training and afterwards.

6.0 STRENGTHS AND LIMITATIONS OF THE STUDY

Researchers gathered the input of the greatest breadth and depth of operational SMEs of any MQ-1 Predator/MQ-9 Reaper RPA study to date. The researchers also employed a hybrid of structured/unstructured interview techniques in different interactional settings to develop a list of the critical attributes of Predator/Reaper pilots. Focus group and multidisciplinary sessions allowed researchers to gain insights in the organizational culture and climate, and individual interviews strengthened the climate for permitting participants to speak openly. Researchers validated the perception of attributes considered critical by SMEs within the multidimensional theoretical profile by employing a sample of SMEs who differed from the first set and by utilizing a hybrid of structured and unstructured techniques and a survey. The strength of the survey was its presentation of operationally defined attributes in the language of SME operators (i.e., behavioral descriptions observable and understood by others). For example, the survey presented "spatial reasoning" as "ability to create three-dimensional mental representations from two-dimensional images (spatial reasoning and construction)." Perceived lack of anonymity was considered an issue, particularly in focus groups. SME participants may not have felt free to be candid or mention certain topics. However, to mitigate possible "chilling" effects on disclosure, commanders were not present during individual interviews. Participants were encouraged to

speak freely at interviews and in group sessions, and their rights to confidentiality were respected.

Although larger numbers and types of SMEs participated in this study relative to many other studies, several types of research activities could improve the validity and reliability of our findings. For example, the reliability of the validation survey results might also benefit from administering it to those previously interviewed and additional SMEs from other service branches or government organizations (e.g., National Guard, Homeland Security) and allied nations (e.g., Royal Air Force) that also operate the MQ-1 Predator or MQ-9 Reaper. Furthermore, researchers could empirically substantiate the results with objective measures, assessing the critical attributes (e.g., subscales of verbal and performance intelligence quotients) prior to entering the training pipeline. Aeromedical researchers may use these measurements to compare with prediction models and regression analyses to determine the weighting contributions of each attribute to confirm their "critical" contribution to performance as perceived by SMEs. These findings would then be applied by aeromedical experts to guide assessment and selection processing of training candidates. It is important to note such a validation study is currently being implemented at the USAF School of Aerospace Medicine.

7.0 CONCLUSION

MQ-1 Predator and MQ-9 Reaper pilot duties are considered to be in a high-risk, high-demand, aviation-related position and pivotal to successful force protection, reconnaissance, and precision-strike operations. Based upon the results of interviews with SMEs, there are multiple cognitive aptitudes, personality traits, and motivational issues that influence performance. No one single domain (e.g., cognitive functioning) is considered sufficient for the acquisition of knowledge, skills, and adaption to operational demands. It is also important to note there appears to be an overlap in the psychological attributes perceived by SMES as critical to performance in other sensitive, high-risk military positions. An assessment and selection program selecting out RPA pilot applicants who are not suitable for the position may be centered on the critical attributes reported by SMEs and theoretically organized in this study. Such a template provides a frame of reference for the selection of tests, measures, and structured interviews for aeromedical evaluations and the development of a Predator/Reaper pilot assessment and selection program. Equally as important, the findings of this study may serve as a valuable tool for medical personnel communicating with SMEs and operational CCs regarding the demands and requirements for successful completion of training and working in an operational RPA environment.

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APPENDIX

Standardized Interview Questions

What distinguishes weapon-deploying and ISR RPA pilot duties from the pilot duties and demands of manned airframes that also have ISR and/or weapon-deploying missions and capabilities?

What sort of cognitive aptitudes and abilities have you observed that distinguish a person who succeeds in obtaining ISR weapon-bearing RPA pilot skills and adapting to the operational demands?

What sort of personality traits do you observe that distinguish a person who succeeds in obtaining ISR weapon-bearing RPA pilot skills and adapting to the operational demands?

What sort of interpersonal qualities do you observe in those who succeed in obtaining pilot skills and adapting to the operational crew resource management demands of ISR weapon-bearing RPAs?

What sort of cognitive difficulties or problems do you observe in someone who fails pilot training or struggles with adapting to operational demands of the ISR weapon-bearing RPA platform?

What sort of personality traits do you perceive would likely lead a person to fail pilot training or have chronic performance problems as an ISR weapon-deploying RPA pilot (to include deployment of weapons)?

What sort of motivational qualities or traits do you observe in those who succeed and are highly satisfied with RPA pilot duties for the Predator or Reaper platforms?

What sort of motivational qualities or traits have you observed that distinguish RPA pilots who have performance problems or difficulties?

LIST OF ACRONYMS

ACC	Air Combat Command
AETC	Air Education and Training Command
AFOQT	Air Force Officer Qualifying Test
AFSOC	Air Force Special Operations Command
AOB	air order of battle
CAP	combat air patrol
CAS	close air support
CC	commander
CIA	Central Intelligence Agency
CRM	crew resource management
DO	director of operations
DoD	Department of Defense
FAA	Federal Aviation Administration
FEA	front end analysis
FTU	Formal Training Unit
GCS	ground control station
IFT	Initial Flight Training
IQC	Instrument Qualification Course
ISR	intelligence, surveillance, reconnaissance
JFC	Joint Firepower Course
MIC	mission intelligence coordinator
NEO PI-R	NEO Personality Inventory-Revised
RFC	RPA Fundamentals Course
RPA	remotely piloted aircraft
SME	subject matter expert
SO	sensor operator
UAS	unmanned (uninhabited) aerial system
UAV	unmanned (uninhabited) aerial vehicle
UPT	Undergraduate Pilot Training
USAF	U.S. Air Force