3. BACKGROUND

PEACE OPERATIONS AND MAJOR THEATER WAR READINESS

Over the past six years USAF fighter aircraft have devoted hundreds of thousands of hours to conducting peace operations missions in the no-fly-zones over Bosnia and Iraq. While it might seem reasonable to assume that fighter pilots engaged in peace operations practice a wide range of tactical skills the discussion that follows reveals that this is not the case. During these sorties crews are unable to practice many of the skills they would need in the opening days and weeks of a MTW. As a result there is wide speculation inside and outside the military that the combat skill proficiency and MTW combat readiness of these crews suffers. Since the beginning of these operations there has been no systematic attempt to analyze the available data to determine what, if any, relationship exists between the number and frequency of training events crews accomplish and their ability to perform critical combat tasks.

The postulated negative relationship between peace operations participation and MTW combat readiness does not mean peace operations are not important, are not part of the “real mission” of the USAF, or should not be conducted. If a negative relationship it may mean that while peace operations are an integral part of the US national security strategy of enlargement and engagement, the more resources the USAF devotes to these “stability enhancing” activities the worse position it will be in if they fail and a major war occurs. In other words, the challenge facing the USAF, and the other military services, is how to strike a balance between operations designed to reduce and prevent international conflict, and operations designed to prepare the USAF (other services) to prevail if and when conflict occurs. In order to strike this balance USAF leaders need to better understand how engaging in peace operations impacts units’ ability to successfully carry out their assigned MTW mission swiftly and with minimal losses.

The Rise of Peace Operations

Prior to 1991 when USAF tactical aircrew took to the skies they were almost always engaged in either high quality peacetime training, or actual combat missions. Following the 1991 Gulf War they began to participate in a significant way in enforcing no-fly-zones over Iraq, and after 1993 over Bosnia. Figure 3.1 below, derived from USAF Reliability and Maintainability Information System (REMIS) data clearly illustrates the dramatic increase in the amount of time USAF fighter crews spent on peace operations in the first half of the 1990's. Additional analysis of this data indicates that on any given day the USAF has about 2 of its 14 active fighter wings orbiting over either Bosnia or Iraq enforcing no-fly-zones.[1]

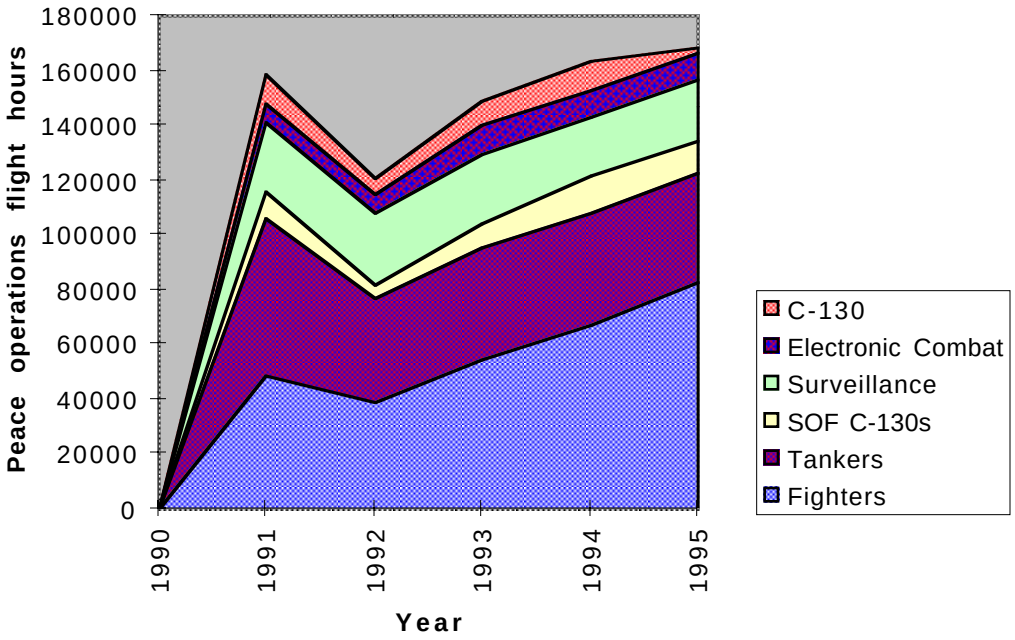

Figure 3.1. USAF Peace Operation Flight Hours per Year 1990-1995

[1]Much of this section is adapted from: Alan Vick, David T. Orletsky Abram N. Shulsky and John Stillion, Preparing the USAF for Military Operations Other Than War, MR-842-AF, RAND, Santa Monica, CA, 1997, Chapter Three. In addition, this document presents a complete discussion of past USAF Military Operations Other Than War (MOOTW) involvement, and an expanded analysis of the extent of current USAF peace operations commitments.

Training Value of Peace Operations Sorties

Over 50 percent of the sorties and hours flown in support of peace operations are flown by fighter or attack aircraft. For these crews there is a tremendous difference between the sort of skills they practice on peace operations missions and the combat skills (low level navigation and weapons delivery, air-to-air combat, missile breaks, etc.) they practice on almost all peacetime training sorties.

Figure 3.2 rank orders the tasks required to successfully accomplish various combat missions from the easiest to the most difficult. The tasks listed are not all-inclusive and some experienced practitioners of the tactical aircrew's art would probably rank some of the tasks in a slightly different order. However, in general the list depicts the easiest, safest and most routine tasks near the bottom and the most difficult, dangerous and demanding tasks toward the top.[2] What is most striking is that virtually all of the MTW combat related tasks are toward the top of the list and none of them are part of the typical fighter peace operations sortie.

---

[2] This ranking of tasks is also consistent with the findings of studies by Tactical Air Command and the Institute for Defense Analysis of USAF and Navy tactical aircrew conducted in the late 1980s to investigate the optimal level of training in various skills. A discussion of these studies is presented in the next section.

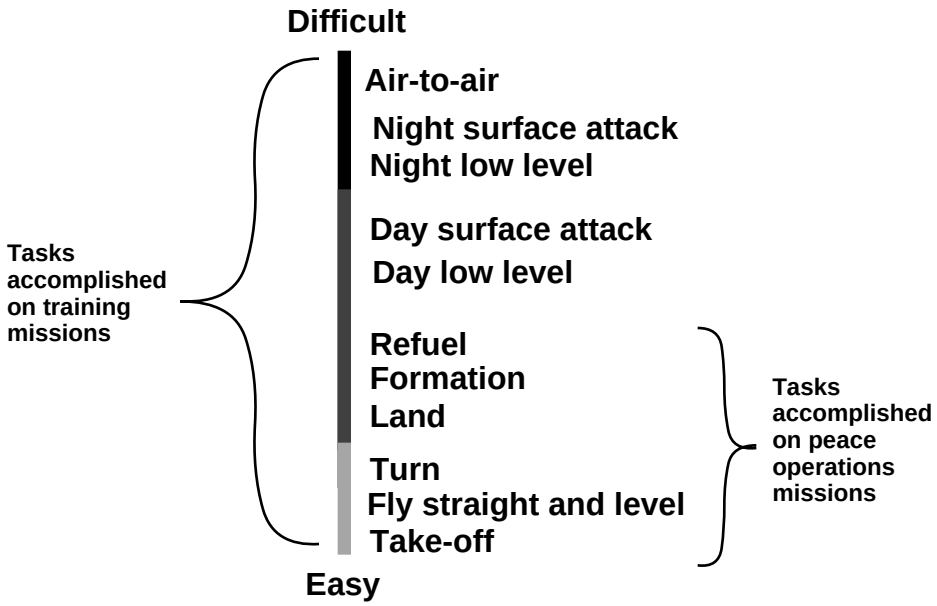

Figure 3.2--Fighter Crew Training Opportunities During Peace Operations

In sharp contrast to typical peacetime training sorties where crews practice low level navigation, weapons delivery and/or air-to-air combat skills, peace operations missions usually offer the opportunity to practice only the most routine tasks. Calling skills like formation flying and landing routine does not mean they are unimportant, or that there is not a certain level of danger or difficulty associated with them. Crews must take-off, land and often refuel and fly in formation to successfully accomplish many combat missions. They must also acquire targets, employ electronic countermeasures to reach them and return home, outmaneuver missiles, engage in air-to-air combat, aim and guide their weapons to impact, while simultaneously maintaining their situational awareness and avoiding collisions with other aircraft or the ground. Peace operations sorties provide fighter crews with virtually no opportunity to maintain their proficiency in many of their most important and perishable combat skills. This is primarily because of the nature of peace operations missions.

As Figure 3.2 illustrates, peace operations sorties for fighter crews consist almost entirely of relatively simple and routine tasks.

They take-off, fly in formation to an orbit point, loiter for a specified time, perhaps rendezvous with a tanker and then return to base. They may get to practice some combat skills, such as coordinating air-to-air radar searches, or medium altitude precision guided munition target acquisition but engaging in the same constant activity day after day with no adversary reaction quickly becomes so mind numbing that crews resort to asking each other movie trivia questions to pass the time while on station.[3]

There is mounting evidence of concern on the part of USAF leadership that peace operations deployments have negatively impacted fighter crew MTW combat skills exactly as described here. The following quotes illustrate these concerns:

> At the Air Force Fighter Weapons School, officials reported a drop in proficiency of incoming students. They could fly medium-altitude tactics, skills used in no-fly zone operations, but were less proficient in low-level tactics needed for high-intensity conflict.[4]

> In 1995, the bust rate for BFM (Basic Fighter Maneuvers) sorties at the (Fighter) Weapons School was 21 percent. In 1996, the rate almost doubled, to 37 percent. The principal reason, said instructors, is simple: Many pilots have spent long tours flying dozens of sorties over Bosnia-Herzegovina or Iraq in support of Air Force contingency operations. These patrol flights, while important to the execution of US global strategy, actually provide poor training.[5]

> But training is constantly interrupted by long overseas deployments, most commonly to Saudi Arabia, home base for squadrons that patrol the no-fly zones in northern and southern Iraq. On these three-month deployments no training in air-to-air combat takes place. 'All you're doing is making left-hand turns all day' said Lt. Col. Ted Kresge, who commands the 27th Fighter Squadron. Pilots deride this duty as 'boring holes in the sky' or 'turning jet fuel into noise.[6]

---

[3]Interviews with F-15E crewmembers who took part in numerous sorties in support of Operation Provide Comfort and Operation Deny Flight indicate this was a widespread, and popular, way to pass the time while on station over Northern Iraq or Bosnia.

[4] "Stretched to the 'breaking point,'" *Air Force Times,* April 21, 1997, p. 3-4.

[5] "Readiness at the Edge," *Air Force Magazine,* June 1997, p. 58.

[6] "Air Force battles pilot burnout, steep dive in numbers", *The San Diego Union-Tribune*, Saturday, June 7, 1997, p. A-21.

> It is the advanced combat skills that suffer as a result of these deployments, and it takes a significant but essential training effort to regain them...[7]

The logical arguments and expert opinion presented above make it clear that there is reason to believe fighter crews who spend large fractions of their flight time engaged in peace operations are less proficient at many MTW combat tasks than those who do not. But how much less proficient are they? Is there a way to quantify how much their combat skills are degraded and if so, to estimate how long it takes to regain them?

PSYCHOLOGICAL STUDIES OF EXPERT SKILL ACQUISITION AND TASK PERFORMANCE[8]

Before addressing the specific questions posed above it is appropriate to examine more general evidence of how deliberate, focused practice affects human skill acquisition, task performance and long-term working memory. Modern psychological investigations of the relationship between task performance (skill) and experience can be traced to de Groot's studies of the role of talent, or individual invariant characteristics unaffected by training , and practice in the performance of chess players.[9]

In work published in 1946, de Groot concluded that chess experts' knowledge and chess-specific reactions were acquired through extensive experience playing chess over a number of years rather than the result of some superior innate ability. At the time de Groot conducted his research many psychologists believed that superior ability in chess, and many other fields of human expertise, was the result of experts'

---

[7] Col. William D Carpenter, Vice Commander, 1st Fighter Wing quoted in "Readiness at the Edge," *Air Force Magazine,* June 1997, p. 61

[8] This section relies heavily on material reviewed in K. Anders. Ericsson and A. C. Lehmann, "Expert and Exceptional Performance: Evidence of Maximal Adaptation to Task Constraints", in Annual Review of Psychology, ed. J. T. Spence et al, 47: pp. 273-305, Annual Reviews Inc., Palo Alto CA, 1996.

[9] See A. D. de Groot, Thought and Choice and Chess, The Hague, Netherlands, Mouton Press, 1946/1978.

superior intellectual capacity for extensive and exhaustive search for superior chess moves. However, de Groot found that expert chess players routinely accessed the best chess moves when they were initially presented with a chess position rather than after an extensive search of all possible moves. This finding indicates that much human expert performance is the result of pattern-based retrieval of superior alternatives from memory. His findings were confirmed and extended by Chase and Simon in a classic 1973 article where they showed that pattern-based retrieval accounts for superior performance in selecting chess moves and proposed that expertise in many other fields – ranging from music to football – was the result of vast amounts of knowledge and the ability to perform pattern-based retrieval attained through many years of experience in an area of specialization.[10] Chase and Simon's hypothesis was confirmed in subsequent research comparing novice and expert performance in analyzing problems in physics[11] and political science[12], medical diagnosis and other fields. Chase and Simon's theory of knowledge based expertise is consistent with prevailing theories of skill acquisition in which knowledge is acquired through experience and then organized into responses (or sets of responses) that become automatic actions with sufficient practice.[13]

Practice is the key to attaining high levels of skill in almost any field of human endeavor. Research has shown that simply exposing people to a task environment for extended periods of time does not significantly increase task performance.[14] Exposure to a task should

---

[10] W.G. Chase and H.A. Simon, "The Minds Eye in Chess", in Visual Information Processing, ed. W.G. Chase, pp. 215-281, Academic Press, New York, 1973.

[11] See M.T.H. Chi, R. Glaser and M, Rees E. 1982, "Expertise in Problem Solving", in Advances in the Psychology of Human Intelligence, ed. R. S. Sternberg, pp 1-75. Erlbaum, Hillsdale, NJ, 1982.

[12] See J. F. Voss, T. R. Greene, T. A. Post, B.C. Penner, "Problem-Solving Skill in the Social Sciences", in The Psychology of Learning and Motivation: Advances in Research and Theory, ed, G. H. Bower, 17:165-213, Academic Press, New York, 1983.

[13] See R.W. Proctor and A. Dutta Skill Acquisition and Human Performance, Sage, Thousand Oaks, CA, 1995 for a review of laboratory studies of skill acquisition.

[14] General experience in a particular domain is only weakly related to task performance for skills ranging from auditing to chess to

not be confused with the amount of time spent on focused activities specifically designed to improve task performance. Psychologists refer to such focused activities as "deliberate practice." There is considerable evidence that the amount of time people spend on deliberate practice is closely related to their level of expertise in a given task or set of tasks. The amount of time spent in deliberate practice activities has been shown to directly effect the level of performance attained by expert musicians, athletes and chess players.[15]

The reason for the weak link between measures of general exposure to a task and skill level is that most activities we encounter in our daily lives – in our jobs, in sports competitions, playing games, etc. – are not structured to allow for the detailed feedback and focused examination of performance necessary for effective learning and skill improvement to take place. In contrast, deliberate practice activities are specifically designed by coaches, managers, instructors, etc. to evaluate and improve particular individual skills through repetition, feedback and refinement.[16] Ericcson and Lehmann observe the following:

> In many domains, knowledge of effective training procedures has accumulated over a long time, and qualified – often professional – teachers draw on this knowledge to design deliberate practice regimens for individual students.[17]

Fighter crew combat skill development is clearly one of these domains. During the course of the Cold War USAF fighter crews developed increasingly refined routines for the systematic planning, execution and meticulous critique of all training sorties. By the late 1980s these

---

baseball to computer operation. See C.A. Ashworth, "Skill as the Fit Between Performer Resources and Task Demands" in Proceedings of the 14th Annual Cognitive Science Meeting, pp 444-449 Erlbaum, Hillsdale, NJ, 1992 for a review of this literature.

[15] See K. Anders. Ericsson, Ralf. Th. Krampe, Clemens. Tesch-Romer, "The Role of Deliberate Practice in the Acquisition of Expert Performance, *Psychological Review,* 100(3): pp 363-406 for a review.

[16] See K. Anders. Ericsson and A. C. Lehmann, "Expert and Exceptional Performance: Evidence of Maximal Adaptation to Task Constraints", in Annual Review of Psychology, ed. J. T. Spence et al, 47: pp. 278-279, Annual Reviews Inc., Palo Alto CA, 1996.

[17] Ibid.

activities routinely involved the examination of film, audio and video tape as well as detailed reconstruction – on whiteboards or with model aircraft - of particularly eventful or instructive phases of flight such as ground target attacks or simulated air to air combat engagements. The post-mission critiques (debriefs) were so detailed they routinely equaled or exceeded the duration of the training mission. In contrast, most peace operations sorties flown since 1991 have afforded USAF fighter crews little or no opportunity to deliberately practice their most important combat skills. One way to interpret the comments made by USAF commanders and Fighter Weapons School instructors presented in the preceding section is that they are describing a situation where USAF fighter pilots have moved from spending almost all of their time on deliberate practice activities to one where they spend considerable amounts of their flight time engaged in general exposure activities that psychological studies have shown contribute very little to skill proficiency.

A final important point on the relationship between practice and performance is that consistency is important. Research has shown that intense deliberate practice causes physiological and neurological changes in the human body and brain. Physical changes such as increased heart size and increased muscle volume in response to exercise are familiar, but recent studies have shown that near-sightedness is increasingly common in developed countries because activities such as reading, working with computers and watching television require sustained focus on nearby objects that causes adaptive changes in the shape of the human eye.[18] Much of human learning consists of the development and maintenance of extensive knowledge structures. Deliberate, focused practice activities forge the connections between facts and experience that forms the foundation for knowledge structures. Additional deliberate practice fleshes out the structure as more knowledge is added and more connections are formed. These webs of connection that constitute knowledge are accompanied by neurological changes in the brain that are analogous to the physiological changes

[18] J. Wallman, “Nature and Nurture of Myopia”, Nature, 371:201-202.

that result from repeated exercise.[19] Other studies have shown that once intense deliberate practice stops skill levels begin to decline.[20] This research has obvious implications for hypotheses about the impact of peace operations on the combat skill performance of USAF fighter crews. However, before presenting these hypotheses in Chapter 4, the following section examines previous studies of the aircrew practice-performance relationship.

PREVIOUS STUDIES OF THE AIRCREW PRACTICE-PERFORMANCE RELATIONSHIP

During the Cold War there were relatively few studies of the relationship between flying experience, recent practice and aircrew combat skills. Those studies were designed to address questions like: "How many hours should tactical pilots fly per month or per year?" While the questions and policy issues involved were somewhat different, the results of prior studies in this area can shed some light on how we can expect peace operations to impact MTW combat skills.

A 1989 study by Hammon and Horowitz at the Institute for Defense Analysis investigated the relationship between flying hours (both career total and "recent practice") and performance of some air combat skills. It found a statistically significant relationship between monthly flight hours and both bombing accuracy and simulated air-to-air combat victories. Statistical analysis of over 1200 Navy and Marine Corps fighter sorties indicates that a 10 percent reduction in total flight time leads to a 2 percent increase in bomb miss distance for ground attack crews and a 5 percent reduction in air-to-air combat victories for fighter crews.[21]

This study clearly shows that we can expect some degradation in the combat skill proficiency of fighter crews engaged in peace operations, with air-to-air skills more sensitive to declines in recent practice

---

[19] See James J. Gallagher, "Teaching and Learning: New Models", in Annual Review of Psychology, ed. J. T. Spence et al, 45: pp. 171-195, Annual Reviews Inc., Palo Alto CA, 1994 for a review.

[20] See K. Anders. Ericsson, Ralf. Th. Krampe, Clemens. Tesch-Romer, "The Role of Deliberate Practice in the Acquisition of Expert Performance, *Psychological Review,* 100(3): pp 363-406

than air-to-ground skills. However, there are serious aspects of the current peace operations situation it was not designed to address. Hammon's and Horowitz's data only allowed them to assess the impact of relatively small changes (on the order of 5 to 10 percent) in monthly flight training hours on aircrew performance - not the impact of reducing training in certain skill areas to zero as our current peace operations Concepts of Operation (CONOPS) require. During the late 1980s when the study was conducted, flight hours were a good proxy measure for actual training accomplished because, for virtually all US military aircrews, the vast majority of time spent in the air was high quality training time. So the variation in training time from month to month for individuals and units was relatively small. With the rise of peace operations during the post-Cold War era this is no longer the case, so more specific input measures of combat related tasks performed on a mission, rather than simply its duration, are now required.

Another study of the relationship between training and tactical aircrew combat proficiency conducted in the late 1980s used somewhat different methods. In his Continuation Training Flying Hours Requirements Study Osborn related data on the number and frequency of training events accomplished by F-15 and F-16 fighter pilots to the same pilots' subjective judgements about their own performance.[22] He estimated "learning" and "forgetting" parameters for a variety of tasks ranging from formation take-offs to various bomb deliveries to air-to-air combat for both experienced and inexperienced pilots.[23]

Osborn's approach is interesting, and for many relatively routine tasks like takeoffs and landings he is able to accurately estimate how many times per month a pilot must practice a task to maintain a given level of proficiency. Task proficiency was rated on a five point scale as follows:

---

[21]See Colin P. Hammon and Stanley A Horowitz, Flying Hours and Aircrew Performance, Working Paper, Institute for Defense Analyses, Washington D.C. June 1989.

[22] James H. Osborn, Continuation Training Flying Hours Requirements Study, Project No. 92-01-03a, HQ TAC/DO, Langley AFB, VA, 1 May, 1992.

[23] Osborn used the standard Air Combat Command (TAC at the time) definition of experience. Pilots with less than 500 fighter hours were considered inexperienced, those with more than 500 hours were considered experienced.

- ONE – NOT PROGRESSING indicates a need for additional instruction in basic concepts.
- TWO – PROGRESSING - indicates additional supervised practice is needed.
- THREE – NEARLY PROFICIENT - indicates additional practice is needed, with no special supervision required.
- FOUR – PROFICIENT - indicates additional practice needed only to maintain proficiency.
- FIVE – HIGHLY PROFICIENT - indicates task performance exceeds standards in all respects.

The 11 tasks rated by F-15 pilots included tasks such as formation takeoff, 4-ship fighter sweep, tactical formation intercept tactics and simulated threat reactions. F-16 pilots also rated themselves on 11 tasks, but because the F-16 is a multi-role fighter capable of both air-to-air and air-to-ground missions while the F-15 is a dedicated air-to-air fighter the tasks differed considerably with F-16 crews evaluating themselves on tasks like low angle low and high drag bomb deliveries, and ground strafing. Interestingly, F-16 pilots rated themselves on landing while F-15 pilots did not. Osborn was able to successfully estimate skill learning and decline rates for many of these skills based on data collected from two fighter squadrons in early 1989.

However, for many of the tasks his sample sizes were extremely small, especially for inexperienced pilots. For many of the categories of tasks under study he had 20 or fewer observations. This lack of data may help explain the relatively large standard errors associated with most of his coefficients for inexperienced F-16 pilots. Osborn’s estimates of inexperienced F-16 pilot performance were statistically significant for only 3 of 11 events - tactical formation, chaff and landing. He was unable to estimate the effect of practice, or lack of it, on what many would consider more important combat tasks such as day intercepts, low-altitude low- and high-drag bomb deliveries, strafe, and mutual support.

In addition, the study’s reliance on pilot self-reports of performance as a measure for the dependent variable – proficiency – has

some practical disadvantages. Such subjective self evaluations are clearly subject to bias, inconsistency, and because they are ordinal rather than cardinal measures of task performance, they are difficult to interpret in concrete terms. For example, judging the practical value of increasing a F-16 pilot's low altitude bomb delivery skills from "proficient" to "highly proficient" is difficult. As with any dependent variable we are better off with a continuous measure of performance such as bomb miss distance which is both objectively measurable and far easier to interpret in terms of practical effect. Knowing a pilot can, on average, put a bomb within 100 meters of a target verses 20 meters allows us to determine whether, again on average, an accuracy improvement of this magnitude would change the likelihood of successfully neutralizing a particular target with a particular weapon. This is far more than we can tell from the subjective criteria defined by Osborn.

In order to assess the true impact of peace operations on aircrew combat skills we need better measures of both inputs and outcomes than those used in either the Hammon and Horowitz or Osborn studies. What we would like to measure is the number and type of training events accomplished over a given time period by USAF aircrew, and then objectively measure proficiency at the important combat tasks mentioned above, or clearly related proxy measures, to determine the true relationships between training, experience and task proficiency. This is exactly the approach adopted in the next several chapters.