Science Fiction No Longer: Enhancing Military Readiness Through Synthetic Training

March 23, 2017 **Jennifer McArdle** *War On The Rocks*

In 1965, the Vietnam War expanded over the 17th parallel into North Vietnam's panhandle and the Red River Delta. Despite its lead in hardware - with access to advanced radars, beyond visual range and close-in heat seeking ordnance, along with large numbers of heavy-bombers and fighter aircraft - the United States failed to achieve air superiority over North Vietnam. The People's Army of Vietnam, supported by its Communist allies, wielded a mixture of sophisticated air-to-air and surface-to-air weapons to devastating effect. By the summer of 1965, American fighters were being lost at a rate of an entire squadron every 45 days. By the end of that year, the U.S. Air Force had lost a total of 174 aircraft and 16 pilots, with another 35 aircrew members missing.

In many ways, one could argue that the U.S. military's use of airpower lacked effectiveness throughout the Vietnam War - not just in 1965. As Air Force Historian Brian Laslie observed, "poor organization, weak command and control, and lack of unity of command all contributed to aircraft losses in Vietnam," however, "those were not as significant as improper training for fighter pilots and bomber pilots." Indeed, as Laslie argues, inadequate training was perhaps the largest contributing factor to U.S. Air Force losses throughout the conflict.

The Importance of Readiness

Combat ineffectiveness can often be imputed to gaps in military readiness - a concept that even the most strategically minded defense thinkers have occasionally struggled to define. According to the Department of Defense's military dictionary, readiness is the "ability of military forces to fight and meet the demands of assigned missions." Looking beyond this somewhat broad definition, readiness at its root depends on the articulation of a coherent strategy: The military must describe what it must be ready for, when it must be ready, and what components of its force structure should be maintained in a state of readiness. If that is not challenging enough, defense planners must then decide what inputs to readiness - personnel, equipment, supply, sustainment, and training - should be allocated to achieve those ends.

While the United States is not in the midst of another Vietnam moment, the lessons from this air campaign are as relevant today as they were in the mid-1960s and early 1970s: A technologically advanced force that fails to attain military readiness may struggle to achieve lasting victory. In 1975, the U.S. Air Force sought to draw on some of these lessons by developing Red Flag - a live fighter training program designed to give pilots a real-world, high fidelity training experience. Today, the live training environment is not conducive to many of the training needs of fifth generation platforms: live training ranges are spatially too restricted for fifth generation training, fail to produce realistic fifth generation threat scenarios, and risk revealing the unique warfighting attributes of fifth generation platforms. These barriers are pressing military operatives to rethink live training in favor of more realistic missions in virtual environments. Indeed, a new wave of simulation technologies is poised to become the "Red Flag" of the 21st century. A blend of techniques, known as live, virtual, and constructive (LVC) training is increasingly viewed as the future of military training. LVC involves linking live platforms (real people operating real systems), to manned simulators (real people operating synthetic systems), and constructive forces (synthetic forces operating synthetic systems).

Training through LVC could be a game-changer for military readiness. We have identified four mechanisms via which LVC may improve military readiness: realism in training, superior knowledge transfer, recruitment, and numerically improved options for joint and coalition training. There is also the added benefit of significant cost savings. Moreover, in the midst of the defense transition from Ash Carter to James Mattis, LVC may provide some semblance of continuity between Carter's emphasis on innovation and technology, embodied by the much touted third offset strategy, and Mattis' prioritization of force readiness.

Enhanced Readiness

Just one week into the new administration, President Trump issued the "Presidential Memorandum on Rebuilding the U.S. Armed Forces," which called on Secretary Mattis to conduct a 30-day Readiness Review of the armed forces. Four days later, Mattis released his implementation guidance, outlining his three priority areas moving forward: improving warfighter readiness, achieving program balance by addressing shortfalls, and building a larger, more capable joint force. Mattis' plan addresses urgent warfighting readiness deficiencies in the fight against the Islamic State of Iraq and the Levant (ISIL), all while preparing to fight and win in future high-end conflicts against great power competitors, such as Russia and China.

Achieving Realism in Training

A common mantra within the U.S. armed forces and other militaries has been to "train as you fight." However, the dogfights and close-to medium-range encounters that characterized much of air warfare in the 20th century have given way to the more deeply contested and long-range combat environments of the 21st. While the end result - realism in training - remains the same, the means to achieve that goal are different.

By combining live platforms with virtual simulation and constructive forces, the U.S. military can train for larger, more variegated operational scenarios. This could involve a wide range of factors, such as cyber-attacks, conflict in the electromagnetic spectrum, saturation attacks of precision guided munitions, and other elaborate cross-domain operations, to include anti-access/area denial (A2/AD) environments. Testifying before the House Armed Services Committee in March 2014, then Air Force Deputy Assistant Secretary David Walker noted that "the training need for LVC is real ... in particular realistic training for [A2/AD] environments is not available." Furthermore, as squadrons of fifth generation fighters increasingly become operational, training requirements are changing. While live training ranges were becoming spatially too restricted for fourth generation fighter engagements, they are now unable to accommodate additional fifth generation requirements for a much wider formation spread. Additionally, the unique attributes of the fifth generation fighter - stealth, sensors, and supersonic guided missiles - precludes operators from testing the plane's full capability in a live environment because of its destructive power and the risk of revealing the aircraft's full potential. As Gen. Mike Hostage stated, "the place where I will be able to take the gloves off, the place where I can turn on all the bells and whistles and get full capability is going to be in the virtual constructive arena."

While the U.S. Air Force, like many air forces around the world, is investing in a blend of live, virtual and constructive training to support fifth generation platforms, the need for LVC extends beyond the virtual replication of air force missions. In many ways, it is already providing a useful means of alleviating the short-term readiness shortfalls resulting from the current coalition campaign against ISIL. Indeed, during our interviews with British military officials last year, officials noted that while the British Army special operations community used to be skeptical of virtual training, it has now emerged as one of its biggest advocates. British Army special operations training includes a joint fires virtual training exercise, entitled Steel Dragon. They consider Steel Dragon to be the most realistic, grueling training that a person can experience pre-deployment to the Middle East. As one military official told us, "When you are having a bad day in Afghanistan, you now call it a Steel Dragon day." The goal, they said, is to "train hard and fight easy."

As coalition forces continue to liberate ISIL controlled strongholds in Syria and Iraq, the group has begun to shift tactics. While ISIL previously sought to control territory, its modus operandi has shifted to waging an asymmetric campaign against civilian populations in major cities. Rapid evolutions in adversary tactics, techniques, and procedures can produce "tiered readiness," where those in the field are better accustomed to developments in enemy warfighting. LVC may help remedy this. The software that supports LVC environments could, theoretically, allow for near-instantaneous modification. Soldiers in the field could update the software package to reflect changing adversary tactics, allowing troops that are stateside to receive training that better reflects current combat realities. In order to make this a reality, the military would need to negotiate the right to update the software with the provider up front - before acquisition.

While nothing can replace the crucible of actual combat, these high-fidelity training systems can also help prepare soldiers for the emotional intensity of warfare. Virtual Battlespace 3, known as VBS3, is a battlefield simulation system that can be catered to the needs of the military, law enforcement, and homeland defense. It often pushes soldiers to the brink of their emotional limits in training exercises. Reflecting on warfighter responses to VBS2, the predecessor to VBS3, Adam Williams, an ex-marine acting as a contractor on the platform confessed,

I've seen people cry ... I've seen people in certain positions get so stressed-out and upset - and we're purposely stressing them out - that they have stormed out of here and sat in their car for fifteen minutes, because they just coldn't take it.

The use of virtual platforms can help first-time soldiers come to terms with the reality of mortal frailty - when their game ends, they can't reboot as their unit plays on.

In addition to training warfighters for the battlefields of today and tomorrow, these systems can also work to heal scars from past conflicts. Indeed, new platforms have been developed that address the moral and psychological toll of warfighting. Beyond the Front, a program that deals with suicide prevention, has garnered so much support that in 2009 the Army made the training mandatory for all active duty, National Guard, and reserve units. Two other virtual reality games have been designed to target post-traumatic stress disorder - Virtual Iraq and Virtual Afghanistan. Through a therapy treatment program, soldiers wearing a mounted display headset are immersed in an interactive environment. Soldiers can brave former traumas without having to summon those older memories - the virtual world designs scenarios that are similar enough to act as a trigger. The goal, Corey Mead notes in his book War Play: Video Games and the Future of Armed Conflict, "is to recreate the patient's original traumatic scenario and then gradually ratchet up the intensity." By confronting those memories in a controlled environment, this form of therapy helps soldiers safely work through those traumatic events.

Superior Knowledge Transfer

The protracted campaigns in the Middle East have demonstrated that the traditional approach to training, with an emphasis on standardization and service role, may not be the best fit for today's challenges. Soldiers are now responsible for a broader range of roles, skills, decisions, and platform-based interactions than before. LVC training has a proven track record of providing better knowledge transfer than conventional training mechanisms. Simulation and simulation-based games have emerged as a preeminent means to acquire knowledge outside of traditional educational institutions - the combination of education and entertainment have proven to be a powerful heuristic method.

While LVC offers a cost-effective way to build muscle memory, it also provides opportunities for more aggressive unit-based training. Units can practice maneuver operations or build common standard operating procedures. Simulation games allows warfighters to engage in complex problem solving. Dutch scholar David Nieborg has noted that simulation games give warfighters the opportunity to develop "skills in practical reasoning, complex problem-solving, making interferences as well as engaging in inductive reasoning [to include] using metaphorical maps to generate alternative solution paths." At the leadership level, the use of constructive forces in an exercise can also add greater complexity, helping to hedge against the tendency of officers to micromanage live assets in the training exercise.

Simulation games also train warfighters to filter information in high-intensity situations. Indeed, when assessing the U.S. Army's first-person shooter military training game-based simulation, America's Army, Colonel Casey Wardynski made the observation that simulation helps warfighters make complex decisions in information-rich environments while under duress. "Our military information tends to arrive in a flood ... and it'll arrive in a flood under stressful conditions, and there'll be a hell of a lot of noise. How do you filter that? What are your tools? What is your facility in doing that? What is your level of comfort? How much load can you bear?"

LVC-based training can be sped up or slowed down based on a soldier's need, providing a tailor-made experience for each war fighter. A 2011 review on the effectiveness of simulation based training concluded that its use - as an alternative to live training, a means of improving performance, or as a mechanism to combat skills decay - outperformed live training in overall knowledge transfer. Furthermore, a 2007 study on the effectiveness of the Tactical Iraqi, a cultural and language virtual training system, found that the group of marines that trained on the virtual platform had the largest increase in knowledge.

Recruitment

The virtual constructive arena is also a useful tool to recruit the next cadre of future warfighters, which includes a new generation of recruits that - unlike previous generations - have been reared on a steady diet of videogames. Indeed, simulation games like Marine Doom and America's Armyhave already proven to be successful recruitment tools for the U.S. military.

Moreover, these simulation games could test the aptitude of recruits to meet skill shortfalls. While the Armed Services Vocational Aptitude Battery has been a staple for entry into the armed forces, it is not necessary the best fit to measure the capacity to meet military-wide skills gaps, such as cyber capabilities. As a result, the military has worked to develop alternative aptitude tests for future cyber warriors. Simulation games could build on the military's cyber aptitude tests, assessing the ability of recruits to make decisions in a fast-paced environment that emulates cyberspace.

Jointness and Coalition Warfighting

The U.S. military notes that today's threat environment is transregional, multi-domain, and multi-functional in nature - threats that are conducive to joint or coalition based operations. Yet, often joint or coalition forces first experience combat together when they are on the battlefield. Few opportunities exist for larger formation training exercises, which is problematic, as group operations are often the most complex. LVC provides geographically distributed forces an opportunity to train together outside of premier training exercises, such as Red Flag and the Rim of the Pacific exercise. Moreover, emerging technologies, such as the "dynamic synthetic environment" may be able - somewhat paradoxically - to inject greater realism into joint and coalition training. Dynamic synthetic environments provide computer-based simulations of the terrestrial world, changing and evolving during training or mission rehearsal autonomously.

Cost Savings

As the United States and its allies grapple with rising personnel and platform costs, LVC trainings offer the potential for substantial defense savings in the long run. The increased use of virtual and constructive training platforms lowers the maintenance costs on live platforms, avoids costly trainee errors, and shrinks the logistics costs associated with complex live cross-domain and coalition exercises. Moreover, the cost differentials between an hour of live flying versus an hour in a simulation are significant: an hour of live F-16 block training is valued at $7,500 in comparison to $900 for an hour of simulation based training. According to the National Training and Simulation Association, the operating costs of flight simulators tend to be between 5-20% of the cost of live aircraft. Furthermore, this trend transcends the Air Force. The Army saves approximately $304 for each hour of training on its UH-60 Black Hawk Simulator, while the Navy expects to save $119 million annually beginning in 2020 by increasing the percentage of synthetic training for its MH-60 and F-18 aircraft by 8 and 14 percentage points respectively.

Geographically distributed forces can also train together in a high-fidelity virtual environment, alleviating some of the administrative and logistics costs associated with large-scale training exercises. Much like the U.S. use of the Distributed Mission Operations Network for synthetic training prior to Red Flag, the services and joint forces can virtually train during the "crawl-, walk-" level workups, saving the few live training exercise opportunities for "run-level" training.

Achieving Continuity: From Third Offset to Force Readiness

While LVC could provide a game changing readiness input for future conflict, it also may provide a modicum of continuity between former Secretary of Defense Ash Carter's focus on the "Third Offset" and Mattis' strong emphasis on readiness.

Since Mattis' appointment, some have suggested that a shift in strategic thinking within the Pentagon is likely to occur - regardless of Deputy Secretary of Defense Bob Work's holdover. In reality, however, these differences have been somewhat exaggerated. Carter believed that winning the next war had less to do technology and more to do with having a cadre of adaptive leaders who can quickly navigate complex problems under the fog and friction of modern conflict. Training the next pool of military of leaders also fits squarely within Mattis' focus area of building warfighter readiness.

Carter had also advocated for the development of new and innovative operational concepts to offset some of the advantages of potential future adversaries. LVC is not simply a training platform, but a tool for innovation and experimentation. New operational concepts, doctrines, technologies, and force structures can be tested in virtual worlds - worlds that can now evolve autonomously to meet changing requirements. As Mattis works to reassess the technologies currently under consideration as part of the "third offset" strategy, those technologies can be tested in virtual environments prior to the start of the acquisition process.

History demonstrates that military disruption - the type of disruption that the Third Offset seeks to realize - arises from a combination of technological and organizational innovation. Readiness requires not just a trained force, but a trained force that can meet the strategic and operational requirements of current and future wars. Technology alone will not be a panacea, as Mattis is well aware. Likewise, a force without continuous access to innovative technology, operational concepts, and strategy, will eventually lose its warfighting edge. These innovations must be adopted before the first shot is fired or the first sortie is deployed. Or as Dan Synder, the co-creator of the Marine Doom scenarios at the Marine Corps Modeling and Simulation Office, has stated, "a real firefight is not a good time to explore new ideas."

LVC provides a means to address some of the readiness shortfalls for the current fight against ISIL, while providing opportunities to test and innovate for the high-tempo conflicts of tomorrow.

Jennifer McArdle is an Assistant Professor of Cybersecurity Policy at Salve Regina University and a Fellow in Defense Studies at the American Foreign Policy Council. Follow her on Twitter @jlmcardle01. Lt. Gen. (ret.) Yvan Blondin is the former head of the Royal Canadian Air Force (RCAF). As Commander of RCAF, Lt. Gen Blondin led the implementation of future synthetic RCAF training. He retired from RCAF in 2015.