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14. ABSTRACT Marine Corps doctrine emphasizes intuitive decisionmaking as the norm and the need to develop leaders accordingly; however, there is neglect to develop intuition to fight a future war against a near-peer adversary. Today's generals entered the Marine Corps when email did not exist, yet they are expected to fight division, group, wing, and corps level units in the information and cyber domains. Intuitive decisionmaking skills must be learned to fight in a future environment that entails swarms of autonomous low-cost kamikaze drones, altered video feeds from the battlefield, the management of machine learning robots, etc. Intuition is learned primarily through experience, and general officer-level training through virtual simulation with artificial intelligence is necessary to build the databank of experience necessary for good intuitive decisions at the high-tactical and operational levels of future war.					
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**Future War Paper**

*Developing Intuition:*

*How Virtual Simulation with Artificial Intelligence*

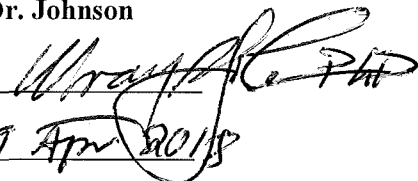
*Can Build Expertise in General Officers*

**SUBMITTED IN PARTIAL FULFILLMENT  
OF THE REQUIREMENTS FOR THE DEGREE OF  
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## INTRODUCTION

Marine Corps Doctrinal Publication (MCDP) 6, *Command and Control*, states that, “Because uncertainty and time will drive most military decisions, we [the Marine Corps] should emphasize intuitive decisionmaking as the norm and should develop our leaders accordingly.”<sup>1</sup> The intuitive approach emphasizes experienced judgement and intuition for decisionmaking rather than deliberate analysis, to generate tempo and provide for flexibility amid uncertainty. Yet questions arise as to what intuition is and how to develop it within military leaders. Future war will require military commanders to use their intuition to make critical decisions on the twenty-first century battlefield, yet the tools necessary to sharpen this skill are extremely limited or nonexistent. General officers at the high-tactical and operational levels of war must develop their intuition, primarily through virtual simulation with artificial intelligence, in order to make sound intuitive decisions that lead to victory amid the chaos and uncertainty of war.

## TERMS AND DEFINITIONS

Confusion can exist when dealing with cognitive and simulation terms. For the purpose of this study, the following terms and definitions are used.

Intuition: Direct perception of truth, fact, etc., independent of any reasoning process; immediate apprehension.

Constructive simulation: Simulated forces that respond to trainee actions. Typically, real human inputs are needed to fully operate these simulated forces, which then carry out the resultant actions in a synthetic environment. Marine Air Ground Task Force (MAGTF) Tactical Warfare Simulation (MTWS) is an example.

Live simulation: Represents the natural environment in which individuals or teams operate systems and platforms for rehearsal and training purposes.

Virtual simulation: Synthetic environments that include the replication of warfighting equipment and operational environmental conditions.

Tempo: The rate of military action in relation to that of the enemy; speed and time generate tempo.

High-tactical level of war: When this term is used, the author refers to brigadier general level command and above, i.e. task force, brigade (USMC only), division, wing, group (USMC logistics).

Operational level of war: The author refers to this term as lieutenant general level command and above, i.e. task force, corps, Marine Expeditionary Force (MEF), army, and army group. Note that both levels of war can overlap within a command.

## THE PROBLEM

The military is inherently a profession of amateurs, whereby commanders invariably are promoted out of a job they know how to do well into a job that immediately demands good decisions, wisdom, and judgement at a higher level, often at a critical moment. Commanders do not arrive at most decisions through the Marine Corps Planning Process or the Army's Military Decision Making Process. As set forth in MCDP 6, important decisions are usually intuitive. When queried about a decision one sometimes hears that a leader "just knew" or had "a gut feeling." In that regard, Michael Matthews, a U.S. Military Academy Professor of Engineering Psychology, states: "Heuristics and intuition play significant roles in decision making...and the key to successful intuition is expertise."<sup>2</sup> Experience is the essence of intuition. Researchers

Chase and Simon found it takes about 10,000 hours of experience for chess masters to attain their high-level of skill.<sup>3</sup> Chess is repetitive with rules and boundaries that both opponents abide by, therefore it is even more important to recognize the shortfalls in true expertise for military commanders as they decide on matters far more complex than playing chess, where lives and material are at stake.

Corps and Marine Expeditionary Force (MEF) commanders today were battalion commanders during Operation IRAQ FREEDOM in 2003, which one could argue was the last major operation on the high end of the Range of Military Operations scale conducted by the US. These commanders were far removed from corps level decisions. After more than a decade of counterinsurgency (COIN) operations, there is likely a shortfall in major combat operations expertise at the high-tactical and operational levels of war. In 2014, the MAGTF Staff Training Program (MSTP) transitioned from Mission Rehearsal Exercises (MRX) to MEF Exercises (MEFEX) and Large Scale Exercises (LSE) to train MEF and Marine Expeditionary Brigade (MEB) level commanders and staffs every two years throughout the Marine Corps. These exercises used live and constructive simulation to focus on major combat operations against constructed near-peer competitors and they highlighted, among other issues, the need to develop intuition in commanders operating at the threshold of the high-tactical and operational levels of war.

In multiple exercises, casualties were so high and the loss of aircraft so significant that in some instances units required resurrection in the simulation to enable further training.<sup>4</sup> Simply put, commanders crossed heavily defended rivers, passed through canyons within the range of enemy artillery, were observed by enemy unmanned aerial systems (UAS), misallocated engineer assets, and built air bases too close to enemy artillery. Though the commander bears

full responsibility for his or her decisions, the reality is that today's generals are products of their placement and schema.<sup>5</sup> Their training and a lot of their combat experience focused on COIN in Iraq and Afghanistan. When they entered the Marine Corps, email did not exist; yet today commanding generals have to fight division, group, wing, and corps level units in the information and cyber domains. Thus, there is an intuition shortfall to fight the next war against a near-peer adversary. Exercising high-tactical and operational level decisionmaking once every two years does not develop the intuition needed in general officers.

## INTUITION

War is based less on theory and more on intuition, experience, and the rules of action.<sup>6</sup> The renowned military philosophers Sun Tzu and Carl von Clausewitz emphasize the importance of intuition in military commanders. Sun Tzu writes of generalship having a clear perception, understanding human factors, and proficiency in exploiting fleeting opportunities.<sup>7</sup> These requirements depend largely on intuition. Clausewitz uses the French term *coup d'oeil*, which he defines as, “[The] intellectual activity...[that becomes] the faculty of using judgment to detect the most important and decisive elements in the vast array of facts and situations.”<sup>8</sup> He continues in that this judgement consists of the intuitive comparison of all factors, and “the most pressing and important points are identified with greater speed than could be done strictly by logical deduction.”<sup>9</sup>

MCDP 6 refers to *coup d'oeil* as, “the ability of gifted commanders to intuitively grasp what is happening on the battlefield.”<sup>10</sup> It further claims that a commander's interpretation of the facts of a situation is based on intuition and judgement, which are products of preconceptions, training, and experiences. Individuals often have a greater intuitive appreciation for the

reliability of information when they observe a situation firsthand, and high-tactical and operational level commands often receive information secondhand thus losing a sense of intuitive reliability about the information. Additionally, information technology has increased so much that information is sometimes not even processed, thus increasing the burden on commanders to make difficult decisions.<sup>11</sup> General Krulak, the 31<sup>st</sup> Commandant of the Marine Corps, in his May 1999 *Marine Corps Gazette* article, “Cultivating Intuitive Decisionmaking,” states: “Advances in information technology will never clear Clausewitz’s ‘fog of war’ to the point where the analytical mode [of decisionmaking] is timely enough to guarantee victory.”<sup>12</sup> He was concerned with developing intuition so that leaders could “feel” the battlefield tempo, discern patterns, and make quick decisions. Summarizing, General Krulak posits, “We [the Marine Corps] must actively seek out means for cultivating intuitive decisionmaking skills from the strategic corporal to the MEF commander...[and] since these intuitive skills result from experience, we must include repetitive decisionmaking drills.”<sup>13</sup>

Naturally, the question to ponder is whether intuition can be taught. Researchers and psychologists have long recognized that intuition has a strong influence on decisionmaking.<sup>14</sup> In some professions and fields of study, individuals who possess an intuitive ability can quickly make sense of a situation and understand what others do not. Professional basketball players call it *court sense*, military professionals call it *coup d’oeil*, and birdwatchers are able to see the bird’s *giss*. This same intuitive sense of knowing applies to art, music, medicine, and more. This can be difficult to ascertain since, as Malcolm Gladwell states, “We live in a world that assumes that the quality of a decision is directly related to the time and effort that went into making it.”<sup>15</sup> He also claims that a quick decision can be just as good as a deliberate one and that snap judgements can be educated and controlled.

U.S. Military Academy professor Michael Matthews reasons that expertise is the key to intuition since experts, compared to novices, are quicker to size up a situation and render judgement.<sup>16</sup> At first glance, an observer might recognize how quick master chess players assess the chessboard and determine an appropriate move. What is not observed are the thousands of games required to build a memory of board patterns, moves, and outcomes. Psychologist Gary Klein concludes that with massive amounts of experience individuals build mental libraries that are matched with observed patterns of a current situation to make difficult decisions in high-risk settings.<sup>17</sup> Thus, experience is the key to intuition and therefore teachable. This is why General Krulak emphasized repetitive decisionmaking. Psychologists Martin Seligman and Michael Kahana offer that intuition is teachable, and that virtual simulation offers the best alternative to the bloody battlefields for military commanders to develop experience.<sup>18</sup> If a commander trains in a sufficient number of simulations of varying scenarios they will have “seen it before” and have a model for sound intuition applied to a present situation.

## VIRTUAL SIMULATION

For centuries simulation existed as a training tool of warfare. During the Roman Empire the military used sand tables and icons to represent soldiers and units as they planned for war.<sup>19</sup> For decades military pilots have used simulators to safely and cheaply experience flying an aircraft. Currently, the Marine Corps is in the process of delivering Tactical Decision Kits (TDK) to every infantry battalion. The TDKs are for low-tactical level training to “enhance decision making, employ a competitive training environment, ...and provide hands-on force-on-force training to allow [Marines] to operate against a thinking enemy and improve tactical decisiveness in any environment.”<sup>20</sup> This concept spans across the Marine Corps and is exactly

what General Krulak intended. It will certainly help develop experience needed for intuition among junior Marines.

Expertise must have experience. The Dreyfus Model of Skill Acquisition offers a useful tool to take into account increments of skilled performance based on experience as well as education.<sup>21</sup> The five levels of proficiency are novice, advanced beginner, competent, proficient, and expert. Table 1 illustrates each level.<sup>22</sup> A study on clinical nursing found that it took two to three years for nurses to reach the competent level.<sup>23</sup> Interestingly, every three years, on average, the Marine Corps moves personnel to a different job. Though an individual retains their experience, consider that a general officer only experiences division or corps level decision making for the two to three years they are in command. Thus, while the Marine Corps has simulators for pilots and TDKs for junior marines to develop proficiency, there is little simulation to offer general officers and their staff the experience necessary to become experts.

Novice	The process of identifying different factors and terms of new work content. Characterized by the novice's complete reliance on rules and procedures. <b>Relies on book knowledge, manuals, personal experience and guidance from others.</b>
Advanced Beginner	One has learned on the job and understanding the context of work. Book knowledge interacts with work experiences. <b>Beginning to learn from mistakes and experience.</b>
Competent	Enough experience exists to internalize routine rules and procedures. Context of a situation is familiar but information and data available can be overwhelming. Begins to develop own plan to operate vice relying on an external plan. One who must interpret and decide what is important; <b>failure or success depends on choices made by them.</b> Conveys a sense of knowing what is at stake
Proficient	Performance in a mode beyond analytical rationality. The mass of experience allows one to process new situations more holistically and to consider actions to address them in <b>a more intuitive manner.</b>
Expert	One who does not have to think about what to do, how to do it, or when to do it but simply does what works. Not baffled in failure due to abundant experience. <b>Calculated probabilities have been incorporated unconsciously into intuitive decisions.</b>

Table 1

The MAGTF Tactical Warfare Simulation (MTWS) is the Marine Corps' primary simulation system for training staffs.<sup>24</sup> MSTP is the primary agency for training MAGTFs (MEBs and MEFs), and they use MTWS to do so. MTWS is a constructive training simulation that supports the full range of military operations to include joint operations. MTWS development started in 1990 and was fielded in 1995 to replace the Tactical Warfare Simulation, Evaluation, and Analysis System (TWSEAS), a system fielded in 1976.<sup>25</sup> During a MEFEX, MTWS requires a team of civilian contractors to move and operate units, as well as response cells (small teams of Marines moving and operating units that represent different levels of command) to manipulate friendly forces. Thus, a significant amount of manpower and hardware is required to train general officers and their staffs.

There are significant limitations to MTWS. It does not have the ability to federate with other constructive simulation systems or C2 systems.<sup>26</sup> In 2016, the Modulation and Simulation Branch of MSTP experimented with trying to federate MTWS with Virtual Battlespace III in order to have UAS feeds sent to the training audience (MEF staff), but there was an unacceptable drop in MTWS performance thus preventing a realistic training opportunity.<sup>27</sup> Portions of MTWS code is over 30 years old, and there is currently no simulation system planned to replace it.<sup>28</sup> Following MEFEX 2016, Lieutenant General Craparotta, I MEF Commanding General, stated that he is not sure that MTWS provides what the Marine Corps needs to gain experience against a near-peer threat in a simulated environment.<sup>29</sup> Currently, MTWS is the only simulated system to provide generals with a training experience actually employing forces as a general officer. Unlike individual simulators for pilots or junior Marines there is no virtual simulation available for general officers to experience fighting divisions, wings, MEBs, or MEFs. General Neller, the 37<sup>th</sup> Commandant of the Marine Corps, has expressed his desire to introduce gaming

and simulation training in the General Officer Warfighting Program – an annual week-long Professional Military Education requirement, hosted by MSTP, for newly selected USMC brigadier generals focused solely on warfighting.<sup>30</sup> Training and Education Command (TECOM) has also recognized the need for enhanced decisions games.

Major General Lukeman, TECOM Commanding General from 2014 to 2017, approved a Deliberate Universal Need Statement for a leader focused decision game.<sup>31</sup> The shortfall identified is the “need for an enhanced [tactical decision game (TDG)] capability that is scalable across the Marine Corps, requires a low amount of resources/overhead to implement and sustain, and leverages current/emerging technologies to easily create and reliably reproduce TDGs to enhance decisionmaking training.”<sup>32</sup> It concludes that there is no computer-based TDG program of record to operate. This is a problem since MTWS is the only computer-based simulation to train general officers, and a MEFEX only occurs every two years due to such a high manpower requirement to operate the exercise. An example of a virtual simulation that the Marine Corps should consider for adaptation is “The Operational Art of War IV” by Matrix Games.

The “Operational Art of War IV” is the seventh edition of “The Operational Art of War” and available for purchase as of November 16, 2017. This \$40 simulation focuses on the operational level of war (between the tactical and strategic levels of war) which is exactly where generals in the Marine Corps should receive individual training. Players can play other players or the computer with the option to choose either side in the battle, i.e. the player can choose to be the Russians or the Germans for Operation Barbarossa (the German invasion of the Soviet Union in 1941). The simulation is geared to make the player think a lot rather than functionally do a lot.<sup>33</sup> With over 200 historical scenarios, players can fight units ranging in size and complexity from a few vehicles to an entire corps.<sup>34</sup> The scenarios range from the American Revolutionary

War and Waterloo in 1815 to Israel in 2006 and Taiwan in in 2016 with a bulk of the scenarios replicating WWII battles. Additionally, players can build their own scenarios using the same tools the programmers used to build the database scenarios.

In each scenario, players fight very complex organizations made up of individual vehicles, weapons, or squads. Personnel in the game may range from elite veterans to conscript recruits who improve performance with experience. The simulation incorporates the realism of hunger and coordinating with unfamiliar forces. Troops must be fed, vehicles must be fueled, and resupply on hard roads is quicker than through rough terrain. Fatigue and weather are factors in the simulation. As an example, snow on the ground begins to melt as temperatures rise during the day causing trafficable roads to become muddy and difficult to traverse. Additionally, there is an ability to accept levels of risk and a “fog of war” option limits information available to the player to simulate the realities of war. Time is also replicated with actions simulated to range from six hours to a full week. The simulation models air, land, and sea action, but the emphasis is on land and sea campaigns. Lastly, the simulation incorporates artificial intelligence (AI) from how the computer decides to fight to how it manages supplies. Future general officers must train on a system like this infused with AI.

## ARTIFICIAL INTELLIGENCE

Researchers for Harvard Kennedy School Belfer Center for Science and International Affairs believe that AI and machine learning represent a turning point in the use of automation in warfare.<sup>35</sup> In a detailed study of AI and the future of National Security, the authors posit that AI will be a transformative military technology much like nuclear, aerospace, cyber, and biotech in years past.<sup>36</sup> In 2015, researchers at Google’s DeepMind developed a computer system that beat

a human Go champion; this was one year after the computer expert who built the world's best Go-playing program estimated that it would take ten years to beat a human Go champion.<sup>37</sup> In 2016, an AI program beat a former Air Force fighter pilot instructor in a high-fidelity air combat simulator; this was one year after the company that developed the tools to create the program was founded.<sup>38</sup>

AI is the next wave of technologies and adversaries such as China have ambitions to be competitive in such areas. In 2016, Qi Lu, a veteran Microsoft AI specialist, left to become the chief operating officer at Baidu – a Chinese company with ambitious plans to become a global leader in AI.<sup>39</sup> China is currently developing a Long Range Anti-Ship Missile with AI in response to current U.S. missile development. In the 2017 National Security Strategy, China is listed as a revisionist power actively competing against the U.S.<sup>40</sup> Future war will involve AI and the Marine Corps must prepare its future general officers to fight with, in, and against AI.

It is not enough for the Marine Corps to procure a simulation that will provide general officers with the expertise needed to make good intuitive decisions in future war, the virtual simulation must incorporate artificial intelligence and machine learning. Just as a bank without databases cannot compete with a bank that has them, a military force without machine learning cannot keep up with one that has it. Battlefield tempo will significantly increase when machines can intelligently make decisions based on sensor data. Machine learning technology could also drastically reduce labor-intensive activities such as that needed for MTWS. This would enable commanders at all levels to experience making more difficult decisions thus increasing their experience and promote better intuition.

Generals who made good intuitive decisions during Operation IRAQI FREEDOM I in 2003 had nearly a decade of experience conducting such a war during Combined Arms Exercises

in deserts of Twenty-nine Palms, CA, and the Army's National Training Center near Barstow, CA. After more than a decade of COIN operations, there is a plethora of experience that likely promotes good intuitive decisions in a COIN environment. As the Marine Corps transitions back to training for major combat operations there is a need for better intuitive decisions in this area. And in fifteen years, future warfare will also require good intuitive decisionmaking in an operating environment that encompasses AI. Now is the time to start building the experience necessary for generals to make good intuitive decisions in future war.

## SCENARIO

Imagine seven years from now, lieutenant colonels in command of battalions no longer spend their time clicking annual training slide shows telling them not to smoke or traffic human beings, but rather immerse themselves in a virtual simulation as a regimental or division commander. Imagine an air group commander immersing him or herself into a virtual simulation as a wing, MEB, or MEF commander, fighting at the high-tactical and operational levels of war. Using a program similar to "The Operational Art of War IV" that has strong AI, these future general officers could experience making difficult decisions through a variety of scenarios ranging from contingency operations, to COIN, to major combat operations. They could command in a virtual simulation with AI that could fight back as well as significantly reduce the human labor necessary for today's systems. They would have experience dealing with swarms of autonomous low-cost kamikaze drones, passing orders to machines rather than people, defending against cyber attacks, and conducting counter AI. They would have emplaced cameras all over the battlefield and used AI to make sense of its content. They would have managed machine learning robots and the uncertainty of authentic or altered video feeds in the

command center. They also would have made the “regular” decisions to surge aircraft, weight a main effort, or accept risk, all while an American public had instant access to information (real or not) about their operations. Imagine if their results were part of their fitness report or considered during selection for promotion. Fifteen years from now, these commanders could have years of experience making decisions as a general officer before they become general officers.

#### HISTORICAL EXAMPLE

After the original plan for the D-Day invasion of Normandy widened to include the Cotentin Peninsula, later known as Utah Beach, Supreme Allied Commander, General Dwight Eisenhower, sought out an American general with amphibious combat experience to lead VII Corps ashore. The VII Corps commander, Major General Roscoe Woodruff, was a promising commander, but he had not led men in an active combat theater. Eisenhower understood that actual battle brought out facets of generals’ personalities that training did not, and he had to have a general that would make good intuitive decisions based on real experience in combat. Major General Lucian Truscott was his choice. Truscott had participated in four amphibious operations in World War II and was a proven leader, impressing even Chief of Staff, General George Marshall.<sup>41</sup> However, Allied high command would not allow this as Truscott had recently taken command of VI Corps in the Anzio beachhead. Eisenhower then chose Major General Joseph Collins, who led the 25<sup>th</sup> Division on Guadalcanal and New Georgia. This historical example demonstrates that experience matters.

## CONCLUSION

In conclusion, decisions in the high-tactical and operational levels of war are often made intuitively. MCDP 6 recognizes this as the norm and requires that Marine Corps leaders be developed accordingly. There are many simulations available to offer experience and develop intuition such as aviation simulators or TDKs for junior Marines. MTWS is the only system available to train general officers and staffs, yet it is extremely limited and manpower intensive. Additionally, general officers may not have the appropriate experience needed to make good intuitive decisions in future warfare. Therefore, they should continually make difficult decisions, primarily through virtual simulation with artificial intelligence, to build the databank of experience necessary for good intuitive decisions at the high-tactical and operational levels of war.

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<sup>1</sup> U.S. Marine Corps, *MCDP 6: Command and Control* (Washington D.C.: U.S. Government Printing Office, 1996), 117.

<sup>2</sup> Michael Matthews, *Head Strong: How Psychology is Revolutionizing War* (Oxford : Oxford University Press, 2014), 65.

<sup>3</sup> *Ibid.*, 27.

<sup>4</sup> The author served on the MSTP staff from 2014 to 2017. During this time he observed I, II, and III MEF Exercises as well as II MEB Large Scale Exercise. He also worked closely with the exercise control group responsible for working behind the scenes to facilitate the exercises. In MCCLL's II MEF AAR, II MEF boldly addresses their casualty situation; they took 2,000 casualties in four days of fighting – 1,000 of which were KIA mainly in the division. Other MEFs had similar outcomes, but are not as forthcoming to address specific numbers.

<sup>5</sup> Placement is that point in life where one develops his or her world view. Schema are frameworks for representing knowledge; it refers to the development, storage, and ready access to complicated knowledge structures. Novices have to rely on taxing working memory to solve problems. Experts retrieve schema that are appropriate for a given situation.

<sup>6</sup> Michael Handel, *Masters of War: Classical Strategic Thought*, 3rd ed. (Oxon: Routledge, 2005), xvii.

<sup>7</sup> *Ibid.*, 267.

<sup>8</sup> *Ibid.*, 268.

<sup>9</sup> *Ibid.*

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<sup>10</sup> U.S. Marine Corps, *MCDP 6*, 72.

<sup>11</sup> Journalists Ted Johnson and Charles Wald of *Wired* reported on November 28, 2017 that a DOD official remarked that 99 percent of all drone video has not been reviewed. This is plausible as they report that in 2011 the U.S. Air Force amassed over 325,000 hours of drone video; with 11,000 drones, that is about 37 years of video gathered by one branch of service in one calendar year. They advocate that Artificial Intelligence should be used to view the video, and they additionally refer to a New York Times report from January 16, 2011 by Thom Shanker and Matt Richtel that discussed the death of 23 Afghan civilians due to information overload. Essentially the drone operator team did not adequately focus on civilians to include children amid the swirl of data. One senior military officer said the deaths could have been prevented, "if we had just slowed things down and thought deliberately." This may be the case, but another consideration is that the decision maker needed better intuition. The *wired* article can be found at <https://www.wired.com/story/the-military-should-teach-ai-to-watch-drone-footage/>. The New York Times piece can be found at [www.nytimes.com/2011/01/17/technology/17brain.html?pagewanted=1](http://www.nytimes.com/2011/01/17/technology/17brain.html?pagewanted=1).

<sup>12</sup> General Charles Krulak, "Cultivating Intuitive Decisionmaking," *Marine Corps Gazette*, May 1999, 22.

<sup>13</sup> *Ibid.*

<sup>14</sup> Martin Seligman and Michael Kahana, "Unpacking Intuition: A Conjecture," *Perspectives on Psychological Science* 4, no. 4 (2009): 399.

<sup>15</sup> Malcolm Gladwell, *Blink: The Power of Thinking Without Thinking*, (New York: Little, Brown and Company, 2005), EPUB eBook, introduction.

<sup>16</sup> Matthews, *Head Strong*, 65.

<sup>17</sup> *Ibid.*, 66

<sup>18</sup> Seligman and Kahana, "Unpacking Intuition," 401.

<sup>19</sup> Roger Smith, "The Long History of Gaming in Military Training," Defense Technical Information Center, <http://www.dtic.mil/dtic/tr/fulltext/u2/a550307.pdf> [accessed December 31, 2017].

<sup>20</sup> Kaitlin Kelly, "Equipping Our Marines: Corps Evaluates Virtual Decision Kit to Supplement Training," Marine Corps Systems Command. [www.marcorssyscom.marines.mil/News/News-Article-Display/Article/1332095/corps-evaluates-virtual-decision-kit-to-supplement-training/](http://www.marcorssyscom.marines.mil/News/News-Article-Display/Article/1332095/corps-evaluates-virtual-decision-kit-to-supplement-training/) [accessed December 31, 2017].

<sup>21</sup> Patricia Benner, "From Novice to Expert," <https://www.medicalcenter.virginia.edu/therapy-services/3%20-%20Benner%20-%20Novice%20to%20Expert-1.pdf> [accessed December 31, 2017].

<sup>22</sup> Shobhana Rishi. "A Grounded Theory Analysis of Novice and Veteran Principals through the Dreyfus and Greenfield Models." Ed.D., University of the Pacific, 2004, <https://search-proquest-com.lomc.idm.oclc.org/docview/305143253?accountid=14746>. [accessed January 1, 2018].

<sup>23</sup> Benner, "From Novice to Expert."

<sup>24</sup> Major Michael Donaldson, "Interview with Maj Michael Donaldson, MSPT Modeling and Simulation Branch Head," interview by Michael Smith. *Marine Corps Center for Lessons Learned*, (September 28, 2016).

<sup>25</sup> Frank Scrivener, "Beginner's User Guide for the MAGTF Tactical Warfare Simulation," Calhoun Institutional Archive of the Naval Postgraduate School,

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<https://calhoun.nps.edu/bitstream/handle/10945/7639/beginnersusergui00scri.pdf?sequence=1> [accessed January 1, 2018].

<sup>26</sup> Donaldson interview.

<sup>27</sup> *Ibid.*

<sup>28</sup> *Ibid.*

<sup>29</sup> Lieutenant General Lewis Craparotta, "Interview with LtGen Lewis Craparotta, I MEF Commanding General," interviewed by Bill Wischmeyer. *Marine Corps Center for Lessons Learned*, (December 22, 2016). interview

<sup>30</sup> General Robert Neller, email to Major General James Lukeman, October 8, 2016.

<sup>31</sup> Colonel Patrick Hittle, "Leader Focused Decision Game" (Deliberate Universal Need Statement).

<sup>32</sup> *Ibid.*

<sup>33</sup> Bill Gray, "Review: The Operational Art of War IV," Wargamer, <http://www.wargamer.com/reviews/review-the-operational-art-of-war-iv/> [accessed January 1, 2018]

<sup>34</sup> Game Manual, "The Operational Art of War IV," 7.

<sup>35</sup> Greg Allen and Taniel Chan "Artificial Intelligence and National Security," Belfer Center Study, <https://www.belfercenter.org/sites/default/files/files/publication/AI%20NatSec%20-%20final.pdf> [accessed December 30, 2017], introduction.

<sup>36</sup> *Ibid.*, 10.

<sup>37</sup> *Ibid.*, 7.

<sup>38</sup> "American Institute of Artificial Intelligence and Strategic Competitive Intelligence Professionals (SCIP) Announce Alliance to Launch Courses in Artificial Intelligence." *Financial Services Monitor Worldwide*, 2017b. <https://search-proquest-com.lomc.idm.oclc.org/docview/1886796523?accountid=14746> [accessed January 2, 2018].

<sup>39</sup> John Markoff, "Pentagon Turns to Silicon Valley for Edge in Artificial Intelligence," New York Times Company. <https://search-proquest-com.lomc.idm.oclc.org/docview/1788194168?accountid=14746> [accessed January 2, 2018].

<sup>40</sup> The White House, *The National Security Strategy of the United States of America* (Washington, DC, 2017), 25, <https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf> [accessed January 2, 2018].

<sup>41</sup> Joseph Balkoski, *Utah Beach: The Amphibious Landing and Airborne Operations on D-Day, June 6, 1944* (Mechanicsburg, PA: Stackpole Books, 2005), 27.

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