# Being in Uncertainty

## Cultivating a New Sensibility in Military Education

Peter J. Denning and Susan L. Higgins

*A version of "Being in Uncertainty: Cultivating a New Sensibility in Military Education" was previously published in Ralph Doughty, Linton Wells II, and Theodore Hailes, eds.,* Innovative Learning: A Key to National Security *(Fort Leavenworth, KS: The Army Press, 2015), 133–54.*

## Abstract

We consider the question: Is military education keeping pace with the task of preparing military people for effective leadership in the emerging highly networked, highly unpredictable world? We examine the nature of the changing environment for military operations. We speculate about leadership identity needed in this environment, possible ways to cultivate the required sensibilities, and the possible role of technology in achieving it. We call for a conversation about how military leadership education might be redesigned and how we might get a new design in place.

*Today's global security environment is the most unpredictable that I have seen in 40 years of service.*

—General Martin Dempsey, U.S. Army Chairman, Joint Chiefs of Staff[1]

*If we were the best of the best, why were such attacks not disappearing but in fact increasing? Why were we unable to defeat an under-resourced insurgency? Why were we losing?*

—General Stanley McChrystal, U.S. Army[2]

We are in the midst of a transformation from a machine age to a network age. The machine age taught us to aspire to predictability, control, and efficiency; the network age confronts us with massive, ever-increasing, intractable uncertainties. Possibilities change rapidly and outcomes are unpredictable. Our military leaders were brought up in a machine age of operations planned and executed in a strongly hierarchical, rule-based, and technology-dominated tradition.

The network age breaks the old rules and demands new ones: it integrates billions of humans and machines into an ever-shifting, semi-intelligent organic system. Effective leadership is challenging because there are no fixed rule sets in the network age. Our education systems, designed in the machine age, do not adequately prepare our military for the emerging new world. Our adversaries, who are not subject to our institutional constraints, are moving into the new age faster than we are. It is time for a new conversation about the design of military education.

The now-famous story of Lieutenant Colonel Christopher Hughes in Iraq in April 2003 gives a glimmer of thinking that should become the norm of the Network Age.[3] He was leading a battalion from the U.S. Army's 101st Airborne Division toward the Shia mosque in Islamic holy city of Najaf, Iraq. Suddenly, they were surrounded by an angry mob, increasingly agitated as the rumor spread that the Americans were there to forcibly take the mosque. Hughes' military training gave him clear rules—protect his men by raising their firearms toward the crowd, fire a warning shot, and be prepared to fire to kill if needed. Hughes recalled later "If somebody shot a round in the air, there was going to be some sort of massacre."[4] Instead, Hughes bucked his training. He ordered his men to drop to one knee, lower their weapons, and smile. Then he ordered them to back away. The crowd parted and he and his men left. No shots were fired on that street that day. Not only did he duck disaster, Hughes won a strategic victory by building trust that the Americans were not trying to take over mosques.

Our Naval Postgraduate School colleague Commander Zachary Staples had an assignment in Iraq in which he got to observe first-hand the devastating effects of improvised explosive devices (IEDs). Up to that point, the military had tried a variety of technology fixes including improved vehicle armor, early detection of explosive chemical residues, and jamming of radio signals that detonated IEDs. These technologies had an effect on reducing IED casualties, but the troops still sustained major injuries because many were not wearing their helmets when an IED hit. Staples asked the men why they did not wear their helmets or the headsets that protected their eardrums from blast overpressure effects. They told him that most convoys were long, hot, and boring—taking off their helmets and their headsets enabled them to listen to their iPods and remain a little cooler. As an engineer, he built a small adapter that gated iPod signals into the helmet headphones so that soldiers could listen to their music with helmet and headsets on, but it automatically switched to the radio channel when needed. Men who used the adapter wore their helmets and sustained far fewer IED injuries. Staples traveled across Iraq offering an IED training seminar in which the graduation token was a free adapter. In the seminar, he showed how to avoid injuries by wearing helmets and using the adapter. He said, "I was able to achieve this innovation and get the buy-in by understanding what was important to them in their everyday culture, and giving them a protective technology that blended into their worlds."[5]

What made Hughes and Staples buck their training? We think they had a sensibility about the social cultures they came in contact with, enabling them to anticipate people's assessments and moods, and find better alternatives than permitted by the existing rules. They followed their sensibilities instead of the published procedures and coped with unexpected contingencies. We think that such sensibility can be cultivated within a new approach to military education. We will speculate about the shape of that approach in this chapter.

Mindful of Albert Einstein's saying, "We cannot solve our problems with the same thinking we used when we created them," we might ask how we can change our thinking for the new age.[6] This is the wrong question for our situation because it implicitly assumes thinking will solve the problems that thinking caused. Instead, we will examine here what kind of human beings we need to become so that we will be effective in the new age. Certainly, we need to think differently, see the world through new perspectives, and make new interpretations. But that is far from enough. We also need to embody new practices of sensibilities toward history, culture, moods, emotions, power, and possibilities—for this is how we will be able to act effectively even when there is no time to think. We will examine in depth what this new way of being looks like and how we might cultivate it.

We use the term "network" frequently in this chapter. We are not referring to a machine-age view of a large network of connected computers but rather to a network-age view of billions of people and machines interacting with each other. The emerging network is both social and technological. The network age brings together computing networks and human networks in a way unseen at any time in history,

**Peter J. Denning** is a distinguished professor of computer science at the US Naval Postgraduate School, Monterey, California. He is chair of the computer science department and director of the Cebrowski Institute for Information Innovation. He has published extensively on computing and education subjects. His most recent books are *The Innovator's Way* (2010) and *Great Principles of Computing* (2015). He holds twenty-six awards for technical and educational accomplishment. He is a former president of the Association for Computing Machinery and is editor of the online Ubiquity, an ACM magazine devoted to the future of computing.

**Susan L. Higgins** is a research associate in the Information Science Department and the deputy director of the Cebrowski Institute for Information Innovation at the Naval Postgraduate School. She is a retired Navy commander and a plank owner in the Navy's information professional community. While on active duty she held numerous leadership positions in commands with missions focused on information technology, space systems, and communications. At the Naval Postgraduate School she led the development of the distance learning program and has designed and taught courses for executive education as well as graduate level courses in command and control and military transformation.

Figure 1. The IBM Blue Gene/P supercomputer installation 10 December 2007 at the Argonne Leadership Angela Yang Computing Facility located in the Argonne National Laboratory in Lemont, Illinois. (Photo courtesy of Argonne National Laboratory)

creating the ever shifting, semi-intelligent organic system we now experience as "the network." The network age has the computational power of the machine age, plus publishing, information sharing, global communications, coordinating, social networking, sharing economies, crowdsourcing, mobility, cheap cloud computing, and more. And it includes a new dark side of cyber crime, identity theft, cyber attacks, dark networks, and black-market "network exploits."

## Role of Computing Technology

Computing technology is a transformative influence behind the changes in our world. We have developed machines of vast computational power and connected them into a vast network. Today's computers are a million times faster and a thousand times smaller than those of fifty years ago. Today's internet has grown to over fifteen billion machines and four billion people. The network of machines and people has acquired a sort of intelligence—the collective amplified intelligence of all the people participating in it. The semi-intelligent network functions more like a biological ecosystem than a huge supercomputer.

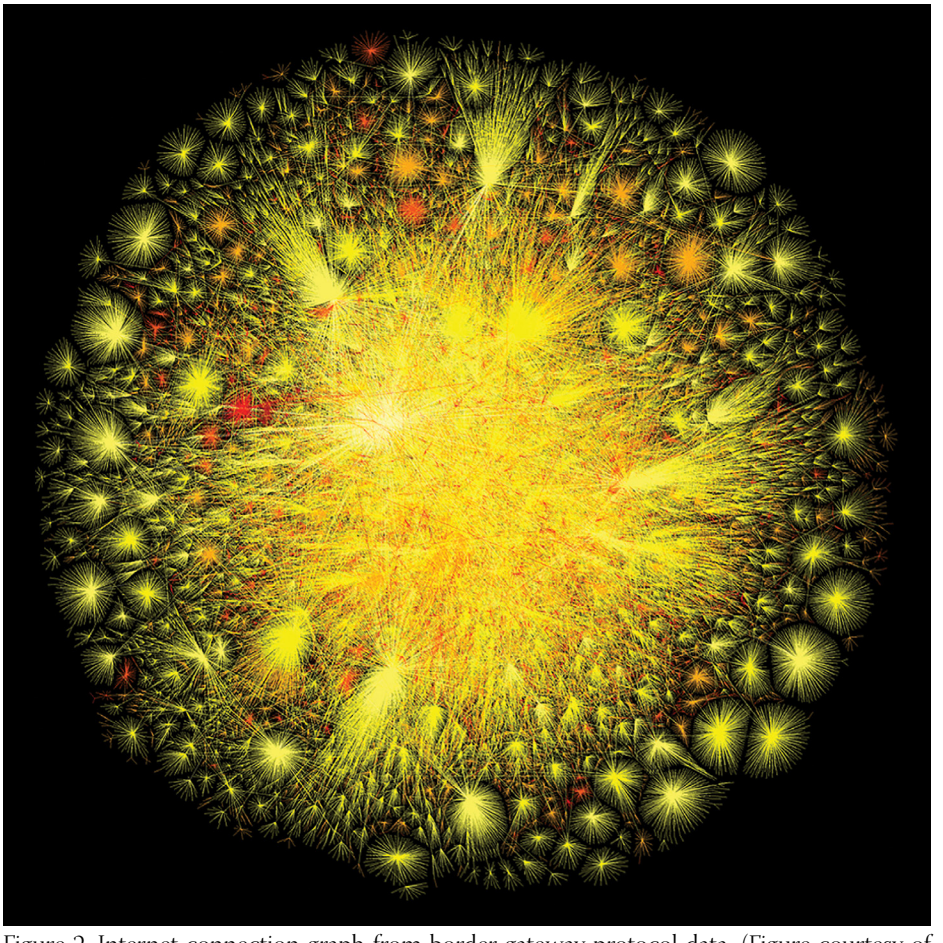

Figure 2. Internet connection graph from border gateway protocol data. (Figure courtesy of Barrett Lyon, The Opte Project)

The first of the two accompanying images (figure 1, page 90) illustrates the computing power we have achieved so far. It is the IBM Blue Gene supercomputer at Argonne Labs. It houses 250,000 processors in 72 cabinets connected by an optical network. It can perform around $10^{15}$ operations per second—a million times faster than the chip in your smartphone. The second image (figure 2) is a beautiful graph of connections between internet sites collected from data on packet traffic in the internet.

The internet is an organic system of humans and machines in a never-ending dance of interaction altering and amplifying each other's capabilities. We are constantly changing the system's structure. Our collective behavior is unpredictable because there is no way to know how interactions among so many people and machines will turn out. This is the context in which military operations are being conducted.

**Table 1**
Examples of Problems Induced by Computing Technology

| | |
|---|---|
| **Large scale sensor networks and situational awareness** | Massive sensory data easily push operators into information overwhelm and present them with a "situation" too complex for their understanding. The large number of people interacting and making their own choices makes prediction impossible. |
| **Command and control of huge networks** | Operators are easily pushed into overload. Great uncertainties are caused by incomplete information and lack of control over adversary actions. |
| **Encryption hides content but not actions** | Strong encryption hides content of messages behind unbreakable ciphers. But metadata, including event records of packet movements, allows inferring plans and intentions of those sending secret messages. |
| **Finding dark networks** | Adversaries take extraordinary steps beyond encryption to hide their communications and networks. But their actions leave "footprints" in the physical world. Can the footprints be correlated and analyzed to infer the contents of hidden communications, locate hidden actors, and even map their social networks? |
| **Automated weapon control** | It seems that the only choice with a very complex system is to develop weapon controllers that decide how and when to use the weapon faster than humans can determine and respond. This is problematic because taking humans out of the loop leaves decision making to machine intelligence that does not understand political and diplomatic nuances. Can we keep humans in the loop? |
| **Cyber attacks** | The attacker's intent ranges from nondestructive theft of information without being detected, to disabling our ability to communicate and coordinate. Should we have backup systems? What might they be? |
| **Swarming operations** | Drone technology is making swarm tactics cheap, feasible, and effective. An aircraft carrier cannot defend itself against a swarm of autonomous bombardier drones. But we may be able to defend with our own swarms of defensive drones. |

Table by authors.

Reinaldo Normand, a Silicon Valley entrepreneur, writes a provocative book about the speed at which digitalization of almost everything, combined with exponential growth of digital technologies in almost every sector, defies our abilities to project what will happen next.[7] He calls attention to 15 digital technology trends, each growing exponentially, that are causing major disruptions in economies and governments—the cloud, mobility, sharing economy, internet of things, big data, virtual reality, 3D printing, bionic implants, biotech, nanotech, artificial intelligence, alternative energies, bitcoin, and digital crime. Exponential trends foster avalanches that sweep away entire industries, long familiar ways of doing business, and identities. Exponential trends and avalanches, rare in the machine age, are increasingly common in the network age.

**Table 2**
Contrasts Between Machine-Age and Network-Age Perspectives

| | | |
|---|---|---|
| 1 | Innovation as idea creation | Innovation as emergence |
| 2 | Knowing more | Exponential uncertainty |
| 3 | Diffusion | Mobilization |
| 4 | Deterministic | Unpredictable |
| 5 | No intelligence | Intelligence |
| 6 | Efficiency | Effectiveness |
| 7 | Managing toward goals | Navigating |
| 8 | Rule sets and end-states | Commitments, moods, power |
| 9 | Sustaining innovation, brands | Shifting identities, disruption, avalanches |

Table by authors.

Military leaders today are trying to come to terms with new realities of warfare enabled by the network context. Here are examples of problems induced by computing technology, but for which there is no technological solution (see table 1, page 92).

## Contrasting Perspectives

There are many contrasts between our machine-age interpretations of our world and the emerging network-age interpretations. We have listed nine examples in table 2, and we will comment on them next.

(1) The first contrast concerns the origins of innovation. Our innovation process models assume that innovation begins with an idea that is then processed through a series of steps until it is embodied into a technology artifact that diffuses through a population. These models make it seem that ideas drive innovation and without ideas there is no innovation; therefore we put great emphasis on creativity and imagination. Yet even with charismatic leadership, our success with creative thinking, strategic plans,

and careful process management is dismal—under four percent of innovation projects make a positive return on their investment.[8] This has been a scourge for the military, which depends on constant innovation to stay ahead of nimble adversaries.

Through our studies of innovation, we are learning that much innovation does not begin with an idea—it emerges in the practices of communities as people respond to concerns using whatever tools and technologies they find around them.[9] Whatever we call the "idea" is often a story invented in hindsight to explain the practice that has already emerged. We are also learning that 90 percent of the work to achieve innovation is involved in adoption of the new practice rather than creating ideas. We are likely to become much more successful at innovation if we let go of the "idea idea" and learn how to foster adoption.

(2) The second contrast concerns the promise of "big data." On the one hand, big data offers vast knowledge of events everywhere in the network and the computational power to locate patterns and causes. On the other hand, the more information we have and the more connected we are, the less we are able to predict. It seems that the increasing numbers of connections and increasing sophistication of automation generate uncertainty faster than they resolve uncertainty.

(3) The third contrast concerns technology adoption. Our machine-age interpretation is that adoption results from information diffusion: people making conscious decisions to use a new technology after receiving information about it through their communication channels and social connections.[10] In the network age, however, we see people unconsciously falling into new practices that attract them by appearing more effective, admirable, or fashionable; leaders foster adoption by mobilizing people in a network to commit to the new practice.

(4) The fourth contrast concerns deep differences between a network of machines and a network of people. Machines are deterministic: they follow definite steps, in definite orders, producing definite outcomes. The network of people and machines on the other hand is non-deterministic: no outcome is certain and it is often difficult even to enumerate all the possibilities available at a given time. Our deterministic rule sets, developed in the machine age, do not work well in the uncertain network age.

(5) The fifth contrast concerns our notions of intelligence. Machines are not intelligent. All you see inside a machine is electronic circuits made of transistors and wires. Whatever we call intelligent behavior of a machine is simply an assessment provoked in us by the machine's designer. When we connect huge numbers of people and machines, the resulting network behaves with intelligence—the collective amplified intelligence of the people using it. The network can aggregate data about our individual movements and make inferences about our future movements. How do we navigate in such an environment?

(6) The sixth contrast concerns the role of efficiency. With machines, we are concerned to minimize waste of time and energy. In the network age, we often have more computing power and bandwidth than we need and our concern shifts to effectiveness. How do we foster the effective outcomes when the tools we find around us are cheap?

(7) The seventh contrast is that in the uncertain, unpredictable environment of the network age we often cannot describe the end-states we seek. We can speak only of possibilities and we wonder how to move in the network closer to the possibilities that interest us. We cannot readily define a path from where we are to where we want to be. Instead, we must find our way amidst the uncertainty, much the same as navigators have historically found their way across uncertain seas to destinations well over the horizon. Instead of defining a path and managing it every step of the way, we explore and navigate through an ocean of uncertainties. We alter course when we encounter unexpected contingencies.

(8) The eighth contrast is the focus on what is most important for achieving outcomes. The machine-age view is that the world is a complex system and the desired outcome (end) is a state of the system. In this view, we define rule sets for how to move in the system and get to the end state. The network-age view is that the desired outcomes depend on commitments that people make. Their willingness to make commitments depends on their moods. The capacity to induce others to make commitments depends on whether they have personal and social power in the network. Clarity in making speech acts such as requests, promises, declarations, assertions, and assessment is essential for developing personal and social power.

(9) The ninth contrast concerns how organizations, industries, and identities evolve. In the machine age, conditions are relatively stable and predictable; organizations have many years to develop brands and earn trust of generations of customers. In the network age, disruptions of brand and identity are increasingly common; avalanches sweep away entire job sectors in just a few years. How do we rebuild if we are disrupted? Manage our moods?

In these contrasts, we have emphasized that the machine-age framework is heavily technological. It looks for technological and rule-based solutions to problems. It seeks to define rule sets for dealing with recurrent problems. Bureaucracies, which achieve machine-like behavior from human organizations, fall in this category and are notoriously slow to change. The military services are deeply bureaucratic. They have extensive rule sets and instructions to cover almost any imaginable contingency and are constantly producing new instructions to cover new contingencies.

In the network age, leaders must become aware of the social context in which technology is used; its history, stakeholders, culture, dispositions, moods, and power exercised by various groups. Vice Admiral Arthur Cebrowski, a network-age thinker par excellence, frequently gave speeches arguing that the two approaches can be brought together through the military doctrine of "commander's intent." He advocated that commanding officers enable forces to organize from the bottom up—or to self-synchronize—to meet the commander's intent.[11] This is similar to McChrystal's principle to delegate decisions on specific actions to the lowest possible level.[12] The Cebrowski and McChrystal interpretations of command are controversial.[13] Too many junior officers fear their careers will be ruined if they break the rules or violate

their chains of command. It will be a real challenge to develop organizational rewards that incentivize the development of network age leaders.

## Deeper Reflection on the Ideation-Emergence Contrast

Let us examine in more detail the first of the contrasts in the list. This is the contrast between the machine age notion that ideas cause or initiate innovation and the network age notion that innovations emerge in the practices of people in the domain. Our success at innovation and staying ahead of adversaries will depend not on idea creation but on how well we master emergence.

Ideation means imagining and creating new ideas for solving problems. The result is a description of the idea, a prototype, and a plan to implement it. The main work of innovation is seen as invention; the work of gaining adoption is buried beneath the lesser term "implement." This notion is attractive because our main models of innovation—pipeline, funnel, diffusion, and innovation cell—all show innovation being initiated and driven by ideas. Moreover, these four models are formulated as technologies—an assembly line, a series of funnels, a communication network, a spinning wheel throwing off sparks. The models themselves exemplify machine age thinking and terminology.

The flaws in this framework can be seen in two major breakdowns mentioned earlier: the four percent success rate of innovation proposals and the 90 percent adoption work factor. We need to spend less time on ideation and more on fostering emergence. Many adversaries are using approaches consistent with emergence (discussed next) and are overtaking us in the novelty of their attacks.[14]

The fundamental problem with the machine-age framework for innovation is that it views the world as constituted of objects to be described and controlled; innovation looks like a process of manipulating and controlling objects. In this framework, innovators must be skilled at planning, selling, executing, managing, and spinning off.

In contrast, the network age brings the interpretation that the world is constituted by practices. Innovation is the emergence of new practices that displace existing practices. Practices are rooted in human interactions, history, conversations, and skills; objects and technologies are tools and equipment to enable and facilitate practices. Emergence means a marginal practice shows up in a community and spreads as people imitate and improve it. They come to embody the new practice, which means they do it without conscious thought.

In the network-age framework, innovators facilitate emergences by exercising by the skills of appropriating, navigating, offering, and mobilizing.[15] If you are not sure what these terms mean, you are not alone. To innovate in the network age, we need to understand and cultivate these skills—and include them in our education of military officers.

## Leadership Identity

McChrystal et al. favor the metaphor of leaders as gardeners, helping people grow their organic networks by tending, caring, watering, fertilizing, and pruning as needed.[16] This metaphor is consistent with our view of network age leaders. Is there a curriculum that teaches in this metaphor? We think it is premature to try to specify a whole curriculum. Let us begin with simple steps, starting with conversations about skills and practices of leaders who will thrive in the network age. Let us also design experiments that help us learn more, as Vice Admiral Cebrowski advised when changing world conditions create new military challenges.[17] We think a good place to start is with a conversation on the identity of a network age leader.[18]

**Leader as Innovator—**The leader understands that missions are accomplished and battles won through innovation. The leader understands innovation as emergence of practices and makes new proposals by responding to concerns and contingencies with new combinations of existing practices and technologies. The leader mobilizes members of the social community to commit to the new practice and bring others along. The leader understands that some pockets of the network will support and others will oppose the proposed change, and helps the team ride with the supporters and seek a turn of mind among the opposers.

**Leader as Navigator—**The leader helps the group find its way through oceans of uncertainties and fogs of war, without having a map of the territory or knowing a clear path to the goal. The leader is prepared to respond and adapt to unexpected contingencies and has prepared the team with the right competencies and commitment to stick together and support each other. The leader sets the direction, provides necessary context, and allows the individual members to make choices based on local conditions while moving in the general direction. The leader expects them to exercise good judgment and ask for help when they do not know. The leader is constantly open to new contingencies and adapts around them.[19]

**Leader as Historical Agent—**The leader respects that all people grow up in different communities that are parts of different cultures, from which they acquired concerns, practices, interpretations, and distinctions. The leader is constantly entering into community conversations that were going on before the leader came along. The leader is interested in other people's histories and their communities, not only to see what concerns them but also to build trust and credibility with them.

**Leader as Opener of Possibilities—**The leader realizes the importance of orchestrating moods to create openings for action toward new possibilities. The leader opens new possibilities by making well-grounded assessments of current conditions and on the basis of those assessments offers new possibilities and ways to make them happen. The leader produces a commitment in the group to move toward a possibility.[20]

**Leader as Appropriator—**The leader understands that every new mission is likely to encounter new communities. An experienced and capable person confronting a new situation must be willing to be a "beginning learner" in the new context. Finding and listening to the "voices" of a community helps to accelerate understanding. Continuous learning practices help a leader "appropriate" a holistic familiarity of a changing world.[21]

The leader's identity is a story that blends attitudes, dispositions, commitments, credibility, and skills in these five areas. Network age leaders must be willing to accept rapid change and adapt to emerging new realities. In other words, the leader's identity is not fixed but is always changing. The leader looks for opportunities in the ever-changing environment and adapts with them. The messiness of this process of adaption may feel uncomfortable. McChrystal notes, "for an engineer educated at West Point, the idea that a problem has different solutions on different days was fundamentally disturbing. Yet, that was the case."[22]

## Toward a New Learning Environment

Designing new learning environments that support the cultivation of network age leaders needs an iterative approach that includes both explorative conversations and experimentation. This should begin with a broad conversation about the breakdowns currently experienced by military leaders, the nature of the world in which they will be leading future military operations, and the aspects of a leader's identity that our education programs should cultivate. At best, we have glimmers and intuitions about these issues.

We might consider speculating about a complete redesign of military schools. Recent examples of redesigned engineering schools are encouraging.[23] The enthusiasm of their graduates is a signal that a bottom-up redesign of engineering curricula might win support and be successful. Given the military's strong focus on engineering, the military service academies at West Point, Annapolis, and Colorado Springs might well explore experiments in a similarly holistic redesign of their engineering curricula.

However, proposals for complete redesign are likely to meet considerable resistance. We favor the less disruptive approach of experiments with modules on transformative practices that can be added to existing programs. One such possibility comes from Frank Barrett who describes how to teach the skill of improvisation to business and executive students using lessons from jazz masters.[24] He proposes an "improvising organization" in which leadership tasks are approached as experiments, routine is deliberately broken in order to encourage serendipity, and everyone has a chance to solo. He suggests that minimal structure and control might maximize autonomy and flow. The WEST program, described in the next section, is another example of a simple educational experiment in cultivating new leadership sensibilities.

## The WEST Experiment

Working Effectively in Small Teams (WEST) is a four-month course offered by Pluralistic Networks, Inc. It focuses on effective leadership of small teams. Using a Skype-like group communication tool called Zoom, students participate from global locations, spending approximately three to four hours each week on coursework. The success of this program flows from its careful attention to how students use language and how that affects their moods and willingness to trust each other. The WEST course was designed by Dr. Fernando Flores, who earned a PhD in Philosophy at University of California, Berkeley, and in a long career became an international business leader, entrepreneur, former senator in Chile, and world-recognized leader in language as a means for communication, coordination, and action. WEST applies education principles developed by Flores and his colleagues in Chile to the issues of small teams.[25]

Flores designed WEST to help people develop and practice skills needed to work in "pluralistic networks"—participants from different backgrounds and cultures must coordinate as members of diverse teams to create meaningful action.[26] A recent WEST class included participants from public and private organizations in the United States, Canada, Mexico, Argentina, Chile, Germany, Australia, Singapore, and Nigeria. They were public school administrators and teachers, artists, personal coaches, military officers, financial executives, cyber experts, and professors. Several held senior positions in their organizations as Presidents, CEOs and Vice Presidents; others were mid-level managers and individual entrepreneurs. This emphasis on pluralistic networks intrigued us because military joint international operations aspire to be effective in exactly that type of environment.

In this experiment, we sponsored a team consisting of six U.S. military officers—a Navy and a Coast Guard Lieutenant Commander, a Marine Captain, a retired Navy Captain and retired Navy Commander, and an Army reserve Major as an observer. They were part of a 30-person class led by Flores. They were initially randomly divided into teams of five. For the first two months, each military member was part of a mostly civilian team; for the second two months, the military members formed their own team.

In weekly assignments, teams read and discussed articles and received initial guidance for planning team operations to be conducted inside the platform of the commercial virtual fantasy game World of Warcraft (WoW). WoW is accessible internationally for under $15 per month and has about 12 million subscribers worldwide. Much like a flight simulator, the WoW virtual world places teams of participants in "quests" that provoke the same moods and reactions as in the real world. WEST uses WoW as a virtual laboratory in which teams experienced challenges with coordination and communication in fast-paced "battles" needed to complete quests. When the challenge was done, each team debriefed in an after-action session and followed up with short written reflections on what they experienced and learned. A coach accompanied them to observe their in-game

actions and conversations and to help them make effective use of the language distinctions in their group debriefings.

An important part of their work together was coordination, not only for in-game operations but also for the team meetings. The basic language element for coordination is Conversations for Action (CFA).[27] Team members were guided through weekly exercises in which they practiced CFAs with explicit declarations, requests, offers and commitments.

A key part of team coordination consists of making assertions (verifiable facts) and exchanging grounded assessments (opinions backed by relevant assertions) about each teammate's performance. The coaches repeatedly emphasized that the assessments should be aimed to help the team achieve its goals—not as personal criticisms or attacks. Many found this honesty tough at first and diluted their assessments with unnecessary verbal filters. Yet, it soon became apparent to all teams that their effectiveness depended on each member's skill in making and receiving these honest assessments. The challenge of doing this well was compounded when team members were from different cultures and backgrounds.

In addition to providing an inexpensive platform for conducting team operations without a physical meeting, WoW evokes participant experience of "being a beginner." Almost all of them are beginners in WoW. Senior people in organizations have often forgotten what it is like to be a beginner. Allowing oneself to be a beginner in an unfamiliar environment and learn how to act effectively is an asset in unpredictable environments. Practicing being a beginner also helps develop a sense of empathy for others, useful as leaders build diverse teams that include members with fresh perspectives.

The participants also joined 90-minute, bi-weekly sessions with Flores held via Zoom. These sessions featured short conversations with each participant about their experiences and provided just-in-time learning opportunities based on participants' questions and concerns.

Preliminary findings include:

- The challenges and quests within the game of WoW elicit various moods and emotions, which can be discussed in terms of how they promoted or hindered working together.
- Core skills for teams working in new, uncertain and emerging environments can be developed and practiced in virtual environments.
- Leadership skills can develop across distance. A common belief is that meeting "in-person" is the only way to develop leadership skills. Developing leadership practices in virtual environments is valuable, especially for organizations where geographically dispersed teams are the norm.
- Participants re-experienced what it is like to be a beginner—an unusual opportunity for developing empathy among seasoned professionals.
- Participants practiced building trust in teams. Many realized they often talk about the importance of trust but have little sense of what conversations actually contribute to creating a sense of trust.

- Participants built relationships with each other. This helped develop a sense of commitment among team members to provide honest assessments and stick with the course.
- Participants created shared understanding by practicing new skills together, further contributing to their mutual trust and team effectiveness.
- Participants had fun. Their enjoyment of their teams and projects kept them engaged week by week for the full four months.
- Participants saw broader value for the course as they considered opportunities to provide the course within their own military services and communities.
- Participants learned to operate across organizational and cultural boundaries.
- Commercial virtual games can be a very cost effective method for training and is much cheaper than organization-specific games.
- The course effectively cultivated several aspects of network age leadership including innovation, navigation, and appropriation.

Based on the students' positive recommendations, we set up a second experimental team for WEST sponsored by the Marine Reserve Forces Command. This group had to blend two different cultures—full-time, active duty Marines and reservists who serve one active weekend a month.

## Roles of Technology in Cultivating Leadership Sensibilities

In the past five years, there has been a marked increase of discussion about technology advances in learning environments. For example, Massive Open Online Courses (MOOCs) use internet-based platforms to make university lecture courses available free around the world and to employ machine learning to customize its responses to each individual student. They are completely automated learning environments (ALEs). An up-and-coming technology is the Online Competency Based Module (OCBM), which focuses on teaching and testing students for specific skills that make up a domain, and then issuing a certificate of competency when the student passes all required demonstrations. The Clayton Christensen Institute promotes this technology and tracks dozens of private companies offering it as an alternative to a university degree for those seeking employment.[28] The OCBM idea is older than MOOCs—it traces back to prediction by Lewis Perelman that a new mode of nonlinear learning, which he called hyperlearning, would gradually become more dominant than the linear syllabi of traditional courses.[29]

What might the role of automated learning environments be in the kind of education we are discussing here? The philosophy of Hubert Dreyfus gives good guidance. Dreyfus is well known for introducing a learning hierarchy in which people grow through the stages beginner, advanced beginner, competent, proficient, expert, and master in their domains. In *On the Internet*, Dreyfus inquired

how far up the hierarchy an ALE can take a student.[30] He argued that ALEs are in effect education expert systems aiming to automate the work of master teachers—and no expert system has ever helped students become more than competent in their fields. The reason is that ALEs are rule-based systems that train conformity to the rule sets in which they were conceived. They are extremely good at training people to become advanced beginners and entry-level competent because those skill levels are highly dependent on rules.

Thus, ALEs could be very useful at teaching the basics of the leadership traits listed earlier. For example, they could provide videos, reading materials, and exercises to help beginners learn basics of coordination. Coordination results from people making commitments to each other. There are only five kinds of commitments—requests, promises, assertions, assessments, and declarations. We have found that most students are not aware of these basic distinctions. When they practice working with them they develop a competence that enables them to bring more projects to completion, detect why projects are falling behind and take corrective action, and develop credibility and trust. We have found that a learning module on coordination is transformative: it helps people in all aspects of their lives, not just in their leadership. We believe it is possible to design ALE technology for a coordination basics module. We suspect that there are modules of basics for supporting leadership development in each of the leadership identities listed earlier.

However, the military asks its senior leaders to go beyond basics and develop a skill level of proficiency or higher. Dreyfus advises that ALEs are not up to the task of bringing people to proficient, expert, or master skill levels. Senior leaders work in environments where the rule sets are constantly changing, whereas an ALE is designed within a given rule set. Master teachers foster learning environments with traditional practices of apprenticeship, conversation, immersion, mentoring, and coaching—practices that cannot be automated. Our challenge in military education is to go beyond technologies when seeking the higher skill levels of leadership.

With a team of colleagues, Dreyfus is featured in a movie, *Being in the World*, which shows six masters from diverse fields and proposes language that allows us to talk about what they do and how they became masters.[31] It is hard to go away from this movie with any impression that any automated learning environment can possibly cultivate mastery.

## Conclusions

The spread of digital technology is transforming jobs, the world, the way we see the world, and the way we interact effectively in the world. The emerging world is more like a constantly-changing ecosystem than a distributed supercomputer built from the network of machines. When a new practice spreads through the system in

exponential growth, the disruptions often seem like avalanches to the large groups of the network whose identities are swept away.

Our future leaders will need to engage and resolve exceedingly complex and unpredictable security challenges. General Dempsey has warned:

> Global disorder has significantly increased while some of our comparative military advantage has begun to erode. We now face multiple, simultaneous security challenges from traditional state actors and trans-regional networks of sub-state groups—all taking advantage of rapid technological change.[32]

Complexity and rapid change, he says,

> characterize a strategic environment in which individuals and groups have access to more information than entire governments once possessed, and can swiftly organize and act on what they learn, sometimes leading to violent change.[33]

The National Military Strategy calls for learning environments that can "build creative, adaptive professionals who are skilled at leading organizational change while operating in environments of great complexity and uncertainty."[34]

In this chapter, we described the skills needed to move effectively in this emerging, shifting, unpredictable world. The skills encompass new ways of thinking and interpreting. They embody new sensibilities about people's moods and possibilities in fast-changing networks. They cultivate moods that facilitate actions. They define a new way of being in and navigating an uncertain and unpredictable world. The new way is not obvious from the machine age in which we grew up and designed our education systems.

We outlined six essential aspects of a leadership identity we think are needed in the new world. We are learning and refining these distinctions through ongoing conversations with an international group and are extracting the ideas that are most relevant for our situation in military education. The need for these skills stems from a change in human dynamics as our world transforms with the help of dramatic advances in digital technology.

At the Naval Postgraduate School's Cebrowski Institute, we have been exploring how to create new learning experiences to meet these needs. We are encouraged by an experiment with WEST that immerses students into practice for effective small teams using virtual worlds. We speculate that by adding a few well-designed WEST-like modules to existing military curricula, we could take significant steps toward the desired transformative effect.

The emerging network age presents profound implications for global security and for the sensibilities that we can cultivate as we design new approaches to military education. We welcome collaborators in our explorations and experiments as we seek to better understand the unfolding of a new era.

## Acknowledgments

We are grateful to John Arquilla, Frank Barrett, Douglas Bissonette, Fred Disque, Hubert Dreyfus, Fernando Flores, Pablo Flores, David Goldberg, Stanley McChrystal, Scot Miller, B. Rousse, and Mitzi Wertheim for conversations and inspirations that helped shape the framework and proposals discussed here. ☙

## Notes

1. Joint Chiefs of Staff, *National Military Strategy 2015*, accessed 26 August 2015, http://www.jcs.mil/Portals/36/Documents/Publications/2015_ National_Military_Strategy.pdf.

2. Stanley McChrystal, Tatum Collins, David Silverman, and Chris Fussell, *Team of Teams: New Rules of Engagement for a Complex World* (Portfolio, 2015), Kindle Location 380.

3. Christopher Hughes, *War on Two Fronts: An Infantry Commander's War in Iraq and the Pentagon* (Philadelphia, PA: Casemate, 2007).

4. Tricia McDermott, "A Calm Colonel's Strategic Victory," *CBS News*, 15 March 2006, accessed 26 August 2015, http://www.cbsnews.com/news/a-calm-colonels-strategic-victory/.

5. Zachary Staples, Commander, US Navy, in personal discussion with the authors 29 August 2015 at Naval Postgraduate School, Monterey, CA.

6. Albert Einstein, BrainyQuote.com, Xplore Inc., 2015, accessed 21 September 2015, http://www.brainyquote.com/quotes/quotes/a/alberteins121993. html.

7. Reinald Normand, *Innovation Squared*, 2015, accessed 26 August 2015, http://www.innovation2.com. An e-book about the exponential growth of digital technologies and the new markets they create.

8. Peter Denning and Robert Dunham, *The Innovator's Way* (Cambridge. MA: MIT Press, 2010), Kindle Location 63.

9. Denning and Dunham, *The Innovator's Way*, Kindle Location 4225; Fernando Flores, "Report of Consejo Nacional de Innovación para la Competitividad," *Surfing Towards the Future: Chile on the 2025 Horizon*, 2013, accessed 26 August 2015, http://chile-california.org/surfing-towards-the-future-into-counselor-fernando-floress-vision-for-innovation; Peter Denning and Fernando Flores, "Emergent Innovation," *Communications of ACM* 58, 6 (June 2015), 28–31.

10. Everett Rogers, *Diffusion of Innovations* (New York, NY: Free Press, 1962, 5th edition 2003).

11. Arthur K. Cebrowski, Vice Admiral, U.S. Navy and John H. Garstka, "Network Centric Warfare," *U.S. Naval Institute Proceedings Magazine* 124/1/1 (January 1998): 139.

12. McChrystal et al., *Team of Teams: New Rules of Engagement for a Complex World*, Kindle Location 3887.

13. John Arquilla, *Worst Enemy: The Reluctant Transformation of the American Military* (Chicago, IL: Ivan R Dee, 2008).

14. John Arquilla, *Insurgents, Raiders, and Bandits: How Masters of Irregular Warfare Have Shaped Our World* (Chicago, IL: Ivan R Dee, 2011); McChrystal et al., *Team of Teams: New Rules of Engagement for a Complex World*, Kindle Location 380.

15. Flores, "Report of Consejo Nacional de Innovación para la Competitividad."

16. McChrystal et al., *Team of Teams: New Rules of Engagement for a Complex World*, Kindle Location 3984.

17. Ubiquity Staff, "Arthur K. Cebrowski on Transformation of Defense" *Ubiquity*, ACM Digital Library, August 2004, accessed 27 August 2015, http://ubiquity.acm.org/article.cfm?id=1022362.

18. Flores, "Report of Consejo Nacional de Innovación para la Competitividad"; Denning and Flores, "Emergent Innovation," 28–31.

19. Denning and Flores, "Emergent Innovation," 28–31.

20. Fernando Flores and Maria Letelier, *Conversations for Action and other Essays* (Charleston, SC: Create Space Independent Publishing Platform, 2012).

21. Denning and Flores, "Emergent Innovation," 28–31.

22. McChrystal et al., *Team of Teams: New Rules of Engagement for a Complex World*, Kindle Location 136.

23. David Goldberg and Mark Somerville, *A Whole New Engineer* (Douglas: Three Joy, 2014); Peter Denning, "The Whole Professional," *Communications of ACM* 57, 12 (December 2014), 24-27.

24. Frank Barrett, *Yes to the Mess: Surprising Leadership Lessons from Jazz* (Boston, MA: Harvard Business Review Press, 2012), Kindle Location 3193.

25. Flores, "Report of Consejo Nacional de Innovación para la Competitividad."

26. Peter Denning, Fernando Flores, and Peter Luzmore. "Orchestrating Coordination in Pluralistic Networks," *Communications of ACM* 53, 3 (March 2010), 30–32; Peter Denning, Fernando Flores, and Gloria Flores, "Pluralistic Coordination," in *Business, Technological, and Social Dimensions of Computer Games*, eds. Maria Manuela Cruz-Cunha, Vitor Hugo Carvalho, Paula Tavares (Hershey, PA: IGI Global, 2011), 416–431.

27. Flores and Letelier, *Conversations for Action and other Essays*.

28. Clayton Christenson Institute, accessed 26 August 2015, www.christenseninstitute.org; Peter Denning, and Daniel Menascé. The website of the Hyperlearning center (1993–2000), which began as the Center for the New Engineer at George Mason University, is archived at http://denninginstitute.com/oldcne-home-archive.html. Accessed 26 August 2015.

29. Lewis Perelman, *School's Out* (Avon, 1992).

30. Hubert Dreyfus, *On the Internet* (London: Routledge, 2001), 33–49.

31. *Being in the World.* Movie (81 minutes) directed by Tao Ruspoli and produced by Mangusta Productions. (Documentary video released 2013), accessed 26 August 2015, http://beingintheworld-movie.com.

32. Joint Chiefs of Staff, *National Military Strategy 2015*, accessed 26 August 2015, http://www.jcs.mil/Portals/36/Documents/Publications/2015_ National_Military_Strategy.pdf.

33. Joint Chiefs of Staff, *National Military Strategy 2015*, accessed 26 August 2015, http://www.jcs.mil/Portals/36/Documents/Publications/2015_ National_Military_Strategy.pdf.

34. Joint Chiefs of Staff, *National Military Strategy 2015*, accessed 26 August 2015, http://www.jcs.mil/Portals/36/Documents/Publications/2015_ National_Military_Strategy.pdf.