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MILITARY PERSONNEL AS INNOVATORS:

AN UNREALISTIC EXPECTATION?

by

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Biography

Lieutenant Colonel Michelle Ewy is assigned to the Air War College, Air University, Maxwell AFB, AL. Lieutenant Colonel Ewy received her commission through the Air Force Reserve Officer Training Corps in August 1995. After her initial assignment as an Air Force chemist at the Air Force Center for Environmental Excellence, she was selected to attend the Air Force Institute of Technology Civilian Institution program and earned her Ph.D. in biophysical chemistry from the University of Virginia in Charlottesville, Virginia. Her follow-on assignment at the Air Force Research Laboratory (AFRL) involved investigating microbial contamination of aviation fuel. Lt Col Ewy was then assigned as an instructor at Air Force Academy in the chemistry department, followed by an Intermediate Developmental Education tour at Argonne National Laboratory as an Air Force National Technical Laboratory Fellow. She then supported the Air Force basic research program as an Air Force Office of Scientific Research, Program Manager and Program Element Monitor at the Pentagon. From the National Capital Region, Lt Col Ewy was moved to Lackland AFB, San Antonio and took command of the Headquarters Air Force Drug Testing Laboratory. Concurrent with her tours at AFRL and the Air Force Academy, Lt Col Ewy also served two 120 day rotations as the Lab Chief of the deployed Aerospace Fuels Laboratory, Al Udeid AB in support of Operations Iraqi Freedom and Enduring Freedom. Prior to her current assignment as an Air War College student, she was the Director of the Department of Research and Publications, Air Command and Staff College (ACSC), Maxwell AFB, Montgomery, AL.

Abstract

Calls for innovation from United States military leaders reverberate throughout the ranks. In an organizational culture that reinforces self-restraint, rewards group-think, and treats white space as wasted space, these leaders have unrealistic expectations of their military personnel. An examination of the requirements for innovation along with recent neuroscience and organizational psychology research provides valuable insight into how the check-list mentality of the military inhibits creativity and innovation. Recommendations to counter these barriers include recruiting creative personalities, training in divergent thinking, providing time for incubation, and promoting innovative leaders. Adoption of these recommendations will embolden military members to be more creative and will cultivate a culture that champions innovation.

Introduction

United States (U.S.) military leaders, raised in a culture strongly influenced by the teachings of the 6th Century military strategist, Sun Tzu, often call for innovation as a way to deal with the quickly dwindling number of actions (and surprises) available to counter an enemy. They ask military members to be innovative *now* to ensure our role as the world's strongest military. Just what are the expectations of these senior leaders? What does being innovative mean to them and more specifically, what do they see as the requirements for innovation? The easiest interpretation is that innovation is the result of military personnel finding creative new ways to use limited funds or innovative ways to use current assets that will cost less than acquiring new ones. However, before one can answer whether or not it is realistic to do more with less through innovation, first one must examine whether or not it is realistic to expect military members to come up with the innovative applications of creative ideas in the first place. Can military members be the innovators the leaders are asking for?

There are well-examined, historical examples of military innovations as proof that individual military members can be creative during a crisis. However, this paper argues that current research in neuroscience and organizational psychology indicates it is unrealistic for U.S. military leaders to routinely expect their personnel to be innovators within an organizational culture that reinforces self-restraint, rewards group-think, and treats white space as wasted-time. To create an environment that fosters innovation, the military must dampen these cultural

practices with those that promote creativity, support diversity of thought, and liberate the time for both to happen.

Creativity vs. Innovation

The terms creativity and innovation are often used interchangeably; however, those who study innovation demarcate important differences. Creativity is the conceptualization of ideas that are both new and valuable.[2] Creative ideas involve synthesizing or integrating processes to identify alternatives. Innovation is the application of creative solutions.[3]

Creativity is "the process of making something strange seem familiar and of making the familiar strange."[4] A creative idea must be "realized" to be considered an innovation.[5] Innovators are seeking solutions. While happy circumstance can lead to great discoveries, from a military perspective, innovation is actively pursued to solve some problem or deal with unanticipated events or crises. We often hear military leaders properly use the term innovation to describe a new technology or new way to use an old technology. Interestingly, though, these same leaders rarely mention the need for more creativity among their ranks. The ease in promoting innovation, but apparent discomfort in doing the same for creativity, is an unfortunate disconnect. Before there can be innovation, a creative mind (or minds) must unveil the enabling idea.

There are three major challenges to the birth of innovation; 1) a creative idea must be conceptualized by an individual or group, 2) the value of the idea as a potential solution must be acknowledged and accepted by the culture, society, or organization, and 3) the solution must be implemented. Figure 1 shows both the actions and organizational enablers required to meet these three challenges and successfully transition from a specific problem to a creative idea to an innovative solution. As detailed in Figure 1 there are four key requirements necessary for an

organization to be innovative: 1) an organization must have personnel capable of generating creative ideas, 2) it must support an environment that champions creativity in individuals and teams, 3) it must be receptive to seeing the value in new solutions, and 4) it must foster the successful implementation of the resulting innovations. This paper will look at these four areas
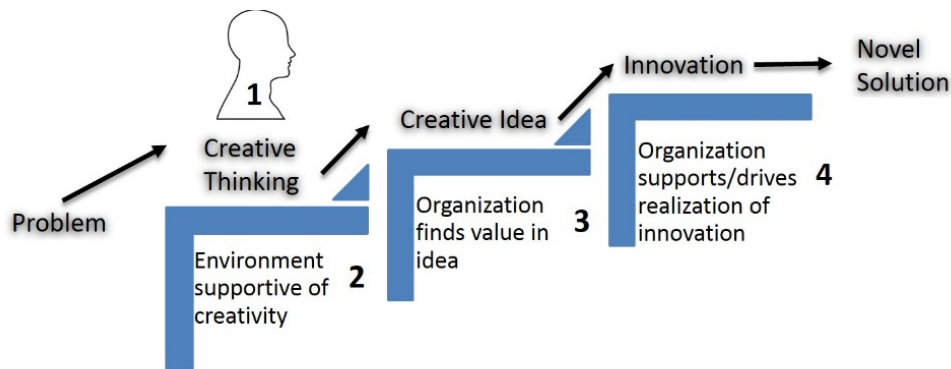

Figure 1. The problem solving process of an innovative organization

through a research-based lens as well as how the military currently hinders significant aspects of each. The paper will also suggest solutions to compensate for these hindrances and help move leader expectations from being unrealistic to reachable.

Creative Thinking

J. P. Guilford, the psychologist considered to have started the modern field of creativity research, described creativity as consisting of two different types of thinking: convergent and divergent.[6] Convergent thinking assesses existing ideas and chooses the best one.[7] The military is well practiced in convergent thinking and routinely publishes best practices in doctrine documents. Doctrine publications are the bedrock for many professional military education programs and are the first "go-to" in determining how to respond in a particular situation. As defined by *Joint Publication 1-02*, doctrine consists of the "(F)undamental principles by which the military forces or elements thereof guide their actions in support of national objectives. It is authoritative but requires judgement in application."[8] The caveat "requires judgment" indicates

that there is some flexibility in doctrine, and the fundamental principles may be tailored to fit a particular situation. As discussed later in this paper, just the perception that there are predetermined solutions or right and left limits can hamper one's ability to conceptualize novel solutions.

In contrast, divergent thinking consists of coming up with multiple solutions, often seemingly unrelated. When ideas are allowed to flow, without being constrained by preconceptions of correct answers, the solutions are more original or "statistically infrequent" and imaginative.[9] Improvisation, when no boundaries or predetermined requirements are placed on ideas, is far-right on the spectrum of divergent thinking.[10] Divergent thinking has been shown in numerous studies to be positively linked to creative performance. Research by Vincent et al indicated that divergent thinking is more strongly linked to both idea generation and implementation (creative performance) than either intelligence or expertise.[11]

Creativity in Individuals

Not surprisingly, it was Guilford that devised the first tests for creativity, which he centered on the concept of divergent thinking. During World War II the U.S. military commissioned him to design tests to help identify the Army Air Corps pilots best able to respond with original behaviors, allowing them to recover from unexpected and potentially catastrophic aircraft equipment failures.[12] Guilford postulated, and current scientific evidence supports, that it is not necessarily those with the highest intelligence quotients (I.Q.s) or the most expertise who are most creative. Yet, neither does the research support that only a chosen few can be creative. Reinforcing Guilford's thoughts that "creative acts can therefore be expected, no matter how feeble or how infrequent, of almost all individuals,"[13] it is currently accepted that everyone has
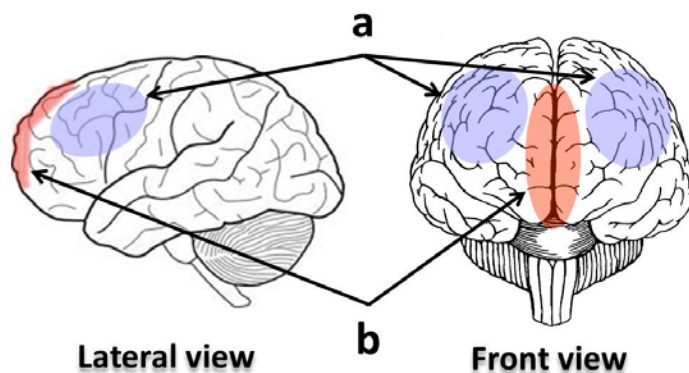
the potential to be creative, just that people rarely are and even those that do, seldom produce creative products.[14,15]

While military leaders' frequent use of the term innovation seems to imply that creativity and the fruition of creative ideas should come easily, the scientific evidence supports an alternative view. Current neuroscience research is revealing which parts of the brain are used during creative activities. The findings provide significant insights into why creativity and, particularly, divergent thinking are hard, especially for military members, who are indoctrinated into a culture that trains them to think from "within the box."

Neuroscience Research

Functional magnetic resonance imaging (fMRI)[16] studies are highlighting the importance of several regions in the brain that are involved in the creative process. Two areas of the brain that have prominent roles are the neural "default network" and the "executive network" (Figure 2). The default network, comprised of primarily the medial prefrontal cortex (MPFC), is considered to be the part of the brain that is activated during stimulus-independent thoughts such as day-dreaming or mind-wandering and is deactivated during task accomplishment or engagement by stimuli. [17] It is called the default network because it was found to be active when other parts of the brain were quiet, as during sleep.[18,19] The executive network is named such

Figure 2. Generalized locations of (a) the dorsolateral prefrontal cortex (DLFPC), the primary constituent of the *executive network* and (b) the medial prefrontal cortex (MPFC), the primary constituent of the *default network*. Adapted from Liu et al. (2012) and Lordan et al. (2013)

because it is the area of the brain associated with higher level thinking and is responsible for "a deliberate, analytic mode of information processing."[20] The dorsolateral prefrontal cortex (DLPFC) is a main constituent of the executive network[21] and "further integrates already highly processed information, formulates plans and strategies for appropriate behavior in a given situation."[22]

In his article "The Cognitive Neuroscience of Creativity" Arne Dietrich describes creativity as occurring through two processing modes: spontaneous and deliberate.[23] His spontaneous process aligns well with the contribution of the default network to the creative process as described by Ellamil et al and other clinical researchers.[24,25] Likewise, the deliberate processing mode, which he attributes to primarily the prefrontal cortex (which contains the DLPFC), encompasses the characteristics of the executive network.[26,27,28] Table 1 summarizes the characteristics of the default and executive networks including the associations with the spontaneous and processing modes.

The spontaneous process, as described by Dietrich, is supported by evidence that creative insights are sparked during times of "defocused attention" like mind-wandering or day-dreaming. He suggests "Kekule's day-dream of whirling snakes forming a (benzene) ring" as an example of such spontaneous creative insight.[29] Keith Sawyer also supports this idea and highlights the relationship between creative insight, mind-wandering, and the "incubation effect," which is the

Table 1. Attributes of the default and executive neural networks

	Primary Brain Region[a,b]	Related Processing Mode[b]	Associated Actions[a,b]
Default	Medial Prefrontal Cortex (MPFC)	Spontaneous	Daydreaming, mind-wandering, affective response
Executive	Dorsolateral Prefrontal Cortex (DLFPC)	Deliberate	Higher-level cognition, judgement, analytical assessment, goal planning

[a] Ellamil et al. (2012) [b] Dietrich (2004)

concept that a creative idea springs forth after "a period of unconscious incubation."[30] Research indicates that people day-dream or mind-wander between 15-50% of the time, the amount of time depending on multiple variables such as task difficulty, fatigue, alcohol-use, and an individual's working memory capacity.[31] The default network is highly active during mind-wandering and even more so when one doesn't realize that their mind is wandering. Most of us have had this experience when we suddenly realized we remember nothing of the last several pages we "read." Sawyer suggests that creative insights might spontaneously pop up after mind-wandering because the hiatus from consciously thinking about a particular issue has allowed for a "mini-incubation."[32] Many people have experienced such an "a-ha moment" of clarity regarding a particular issue when they were doing or thinking about something totally unrelated.

The deliberate processing mode, just as the name suggests, requires a systematic evaluation of ideas to determine the best answer. The term "Edisonian," a way of solving problems by trying one idea, adjusting and then trying again is a good embodiment of the deliberate creative process as well as the creative contributions of the executive network. Dietrich describes the prefrontal cortex as playing three roles with respect to creativity. The first is to hold a thought in working memory since one must grab onto a creative spark before it can be evaluated.[33] His description of the first role reveals synergies between the default and the executive networks. The prefrontal cortex is responsible for working memory, and since it cannot work non-stop, it may be that the sudden sparks of creativity arise during mind-wandering as the prefrontal cortex takes a break, "allowing unconscious thoughts that are comparatively more random, unfiltered, and bizarre to be represented in the working memory."[34] The next role for the prefrontal cortex and its higher cognitive functions is to evaluate which ideas are worth pursuing. Once grasped, one must determine if a new spark should being kindled

into something bigger. The final role Dietrich describes for the prefrontal cortex is following through on implementation of the idea, to include planning the goals necessary to bring the idea to into being.[35]

Of particular interest with respect to the last two roles, evaluation and implementation, is that the prefrontal cortex contains the foundational principles for an individual's beliefs and values. As a result, during the deliberate evaluation process, creative ideas will be judged in context of that value system.[36] If an individual has strongly embraced a particular organizational culture, their evaluations will be constrained by the values of that organization. Someone raised or trained in a culture less tolerant of novelty will have new (therefore, potentially risky) ideas squashed by his or her executive network "gate-keeper" much more quickly than an individual "grown" under more liberal conditions. The executive network is necessary in creative convergent thinking to help identify the "right" answer but can be detrimental to creative divergent thinking by stopping novel thoughts before they are even realized.

Blocking divergent thinking might not just slow innovation, but in a military environment it might also be dangerous. Improvisation, the most extreme form of divergent thinking, provides the "unscripted behaviors" [37] necessary to adapt to a new environment or to respond quickly to unforeseen and potentially catastrophic events (such as an aircraft instrument failure). Recent fMRI evidence indicates that to truly improvise, an individual may have to silence the judgmental gatekeeper by deactivating the executive network.

Two different studies investigating how the brain behaves during episodes of musical improvisation found this to be the case. Functional MRI measurements indicated that during improvisation, the MPFC was activated whereas the DLPFC and the lateral orbitofrontal cortex (LOFC) were deactivated. [38,39] The researchers' findings suggest that in order to allow for

creative improvisation, the default network is turned-on but the brain turns-down the executive network, particularly those parts believed to be associated with focused attention, self-monitoring, and goal-achievement.[40] These deactivations of the oversight and control mechanisms allow for "a state of defocused attention" that supports improvisation.[41] This deactivation is also believed to play an important role in allowing "spontaneous unplanned associations, and sudden insights or realizations."[42] It is just such insights and unexpected realizations that support divergent thinking and lead to the creation of new, novel ideas from seemingly unconnected concepts.[43] These studies strongly suggest that in order to truly improvise, the ultimate form of divergent thinking, one must be willing to allow ideas or solutions to come forth freely without judging their correctness as they arise.

Unlike the jazz and rap musicians studied in the research described above, most people have not developed the ability to "flow" and spontaneously improvise. Ellamil et al conducted a study looking at a more common place creative process: drawing a picture. Using a custom built drawing tablet, the researchers used fMRI to measure the brain activity of art students who were either generating, tracing, or evaluating illustrations for a (fictional) book cover. The study indicated that the neural processes used during the two separate phases of the creative process, generation and evaluation, are themselves separate. During the generation phase, the medial temporal lobe (MTL) memory region, which has been shown to be involved in memory retrieval, had greater activation. [44] The default and the executive networks (the MPFC and DLPFC regions respectively) were more highly activated during the creative evaluation phase.[45] The implication of both the default and executive networks in creative evaluation is an interesting contrast to the musical improvisation research where the default network was activated and the executive region deactivated. Ellamil et al postulate that the involvement of the default network, which in

addition to being activated during mind-wandering, has also been shown to be activated during the processing of emotional information and, therefore, may play a role in providing a "gut reaction" to a particular option during creative evaluation.[46] The activation of the executive network during creative evaluation indicates that there is significant goal-oriented control required to evaluate and select the appropriate creative solution. This assessment aligns with the understanding that the prefrontal cortex judges thoughts against its rule-set (an individual's beliefs and values) as described by Dietrich.[47] As a whole, the evidence supports that creative evaluation, determining which creative ideas have the most value, is a combination of the spontaneous thought and gut-feelings of the default network coupled and integrated with the deliberate assessment of the executive network.[48]

The neuroscience research discussed above provides exceptional insight into why creative thinking, in particular divergent thinking, is difficult for most people and why it may be even harder for military members. The biggest hurdle is the effect of the restraining military culture on an individual's value systems and norms. A military leader may tell a subordinate, "I want you to be innovative, I want you to think out-of-the-box." Or, a doctrine document may state that it is okay to use judgement. These words are fighting against a belief system that was forged through emotionally laden basic military training (dress alike, act alike, don't get out of step, don't mess up or you and your teammates will suffer). The system is then continuously reinforced by a hierarchical organizational structure in which superiors decree what will be done, when it will be done, and even how it will be done. "Good soldiers" follow orders because they don't want to risk people dying or the mission failing, or more cynically, they don't want to get in trouble and hurt their chances for promotion.

Just like a military organization shapes members' physical bodies through training, it also shapes their mental norms, and these norms restrict the novelty of the ideas that the executive network will let through. A restricting culture may even play a role in what one day-dreams about, potentially effecting both divergent and convergent thinking. One hypothesis regarding the default network is that when activated, as during mind-wandering or dreaming, it acts as a "life simulator." It allows one to examine past experiences and relate them to current circumstances or use past experiences to help make predictions about future events, particularly regarding social interactions.[49] A military member who makes an out-of-the-box (creative) suggestion and is reprimanded by their supervisor or mocked by their peers will internalize that experience. The default system may relive that experience when considering other novel ideas during mind-wandering and provide a negative visceral response, stopping the idea before it ever has a chance to be considered by the executive network.

Even with these barriers, creative ideas are still realized in the military and innovation happens. How so? If the ability to think divergently is typically blocked by indoctrination into such an organizational culture, then how does it happen? Some individuals have more malleable belief systems that are not cemented firmly to those of their organization. They may think differently all the time or just in response to a crisis. They are able to see around the cultural norms, be unconstrained, and think more creatively than the rest of us. Often they are called "rebels" or accused of insubordination (until hind-site shows their brilliance.)[50] What are the characteristics of these creative individuals? Is it possible to foster the same traits in the less creative?

Other Research on Individual Creativity

During a groundbreaking speech to the American Psychological Association (APA) in 1950, Guilford introduced the idea that creativity is the consequence of a person's personality, and their creativity will depend upon "motivational and temperamental traits" to include such characteristics as emotional state, excitement towards a task (intrinsic motivation), and confidence.[51] Sternberg and Lubart agree that being a creative person isn't about I.Q. but rather "a particular set of personality attributes" that include being willing to "take chances" and "to take a stand."[52] Author Mihaly Csikszentmihalyi will only commit to saying the creative personality is *complex* and he implies that complexity is expressed as an adaptability that allows an individual to be creative in different environments.[53]

A 2015 study by Silva da Costa et al integrated the results from seven previously published meta-analyses that had investigated the correlations between individual traits and creativity. The study found that the personal traits of emotional intelligence, divergent thinking, openness to experience, creative personality, intrinsic motivation, positive affect, and androgyny are associated with creativity. Age, intelligence, extraversion, self-efficacy, a pro-risk attitude, and being female were also found to be associated with creativity but to a lesser degree. Extrinsic motivation, to include rewards and pressures (as one typically expects from the military), was found to be positively correlated to creativity but much less so than intrinsic motivation. Both divergent thinking and convergent thinking were associated with creativity but divergent thinking was more strongly associated with creativity, and was also associated with innovation in the workplace.[54]

These findings highlight an additional way the military inadvertently inhibits creativity and innovation: it discourages creative personalities from joining in the first place, or if they do

join, it trains them to hide their creative traits to minimize conflict. One need only look at any one of the service's basic training bases to see how much greater a role extrinsic motivation (a sergeant yelling) and convergent thinking (there is only one right way to polish boots) play and how risk-taking (not following the rules), divergent thinking, and perhaps even emotional intelligence (empathy in battle is dangerous) are discouraged. While da Costa's research provides evidence that certain individual traits are indicative of creativity, research is also being done to investigate the idea of creativity being transient and depending not just on the person but on the context of the situation.[55]

Enabling Creativity and Driving Innovation

Creativity and Innovation in Organizations

The purpose of the military is to fight wars and as such it is important for all members of the organization to be trained so that they know precisely what do, when to do it, and how to do the task (march in formation, drive a tank, fly a plane) precisely and predictably the same way every time. Leaders need to know exactly what to expect from their people to ensure the complex movements of thousands of troops are meticulously choreographed. This means by agreeing to wear a military uniform, military members are also agreeing to become part of a team with a uniform understanding of the mission. This understanding requires the personnel to first learn the applicable doctrine and then rigorously follow standard operating procedures (SOPs) and check-lists.

The military organization routinely takes convergent thinking and "the right answer" to the extreme. Along with requiring individuals to conform to look like one another and perform tasks identically, any request for changes in procedures (potential innovations) must be funneled up through the chain of command for approval, facing scrutiny at every step ("Why? This is the

way we've always done it?"). Even after leadership has approved, changes cannot be enacted until multiple levels of the organization agree and all supporting documents have been officially updated. By ensuring such absolute consistency one may be able to reduce the risk of unforeseen consequences, but it also squelches creativity and innovation.

Why even think of trying something different when one will be chastised for not "falling in line"? Rather, it is easier and more likely to result in a promotion by sticking to the check-list. Herbert Shepard describes how individuals in an innovation-resistant organization see attempts of introducing innovation, "For the dependent person who is 'a good soldier', responsive to the formal structure of authority, the risks have to do with job security and the threat of his chances of a raise and advancement in the structure. He avoids innovation and checks innovators."[56] Shepard was not specifically describing a person in a military organization, but the ease of which a military analogy is used and understood to represent an organization that has an anti-innovation culture is noteworthy.

Counter to the description of an innovation-resisting organization, Shepard defines the characteristics of an innovation-producing organization as, "…continuously learning, adapting to changes within itself and in its environment, and successfully innovating in that environment."[57] While the military certainly can embody all of these characteristics, at times, neither the overarching culture nor the tedious bureaucracy support rapid or radical changes.

Another barrier to creativity, which is not exclusive to the military, is being so busy that there is no time available for personnel to stop and think. This lack of time for reflection or mind-wandering inhibits the default network's ability to incubate and make new, novel, and creative connections. Several commercial organizations famous for their cultures of innovation, including Google and 3M, give their personnel 20% and 15%, respectively, of their work time to

pursue independent projects that are of interest to them but may be only tangentially related to their company's work. 3M's now ubiquitous Post-It notes resulted from this permissive "free-time."[58,59]

Leaders

Creativity and innovation in organizations has been shown to not just depend on the employees' ability to be creative but also on the organization's leadership. The most prominent effect occurs when creative, innovative leaders set the example and foster a culture of creativity. Steve Jobs of Apple and Jeff Bezos of Amazon are prime examples of executives of successful and highly innovative companies, who were actively engaged in the innovation process themselves.[60]

In addition to role-modeling, how the leaders interact with their personnel has an impact. Transformational leaders, who are able to raise the performance level of their followers by raising their personal values and self-concepts, are able to positively influence employees' creativity and an organization's innovation.[61] A "close-monitoring" leader will have the opposite effect on creativity. In her article "Leading for Creativity", Professor of Management, Jing Zhou, describes how instead of supporting diversity of thought, a micro-managing leader will create fear, tension, and hesitancy within their subordinates and as a result stifle creativity in their organization.[62] An empowering leader, one who shares power and transfers responsibility and autonomy to the subordinate, has a positive effect on employee creativity. This positive effect is thought to arise because the leader's empowerment promotes the employee's intrinsic motivation.[63,64]

Teams

Along with how a leader interacts with their personnel, the individuals the leader chooses for particular teams affects the likelihood for creativity and innovation. The military, by nature a team-centered organization, has the potential to be highly innovative based upon the evidence that teams can be more creative and generate higher-impact innovations than individuals.[65] Additionally, the military composition is fairly diverse, with men and women from all parts of the country, different socio-economic positions, and different racial and ethnic backgrounds. One can easily link the neuroscience factors that shape an individual's creative tendencies with the importance of diversity on group-level divergent thinking. If an individual's experiences shape both the emotional response of their default network to new ideas and also determines the belief system used by their executive network to evaluate those ideas, then it follows that a team made up of members with very different experiences should come up with more original and more divergent ideas than a team comprised of individuals with similar experiences.

While differing views within a diverse team can give rise to a higher number of novel ideas, heterogeneous teams can be more prone to conflict and therefore take longer to innovate.[66] This counterpoint highlights why like-minded consensus or "groupthink"[67] is often institutionally reinforced—everyone easily and quickly agrees on a solution. Leaders praise the team for their efficiency while individual team-members are intrinsically rewarded with feelings of being valued and belonging. The tug-of-war over ideas will be greater in a diverse group, but research indicates the positive benefits for an organization outweigh the inefficiencies.[68] A "shared sense of purpose and a shared commitment to the group's goals," helps overcome these struggles and supports creativity in diverse teams.[69] The military is well known for fostering a

strong vision and sense of mission among its members and should be able to reduce such diversity-related challenges.

The type of diversity appears to make a difference when it comes to fostering creativity. Differences in educational background or job expertise are more supportive of creative thinking than differences in gender, ethnicity, or nationality.[70] This is something to consider, since the Western idea of diversity often means a group with different racial or ethnic backgrounds which may or may not include individuals from different disciplines or functional areas. This is particularly thought-provoking since military members may originally come from different educational or professional backgrounds, but after years of training and living within the military culture, the differences may fade. Research also supports that while teams have the potential to be creative and innovate, if the organizational leader, procedures, or cultural norms are too strict, teams can slip into groupthink and innovation will be stifled.[71]

There are some interesting dichotomies when it comes to optimizing groups for creating innovation. If the problem the group is trying to solve is well defined, then groups that share the same amount of background knowledge on the topic find more creative solutions. If the problem is ill-defined and the group is tasked with determining the problem, groups from different backgrounds and expertise develop more creative answers.[72] The military has opportunities to take advantage of both types of situations since it has such a numerous and diverse pool of personnel.

Mathematical computational research on "collective wisdom" also provides insight into the importance of expertise and diversity in the group convergent thinking that leads to creative idea selection. Hong and Page provide statistical models that demonstrate the accuracy of a group is dependent on composition or expertise. The group must either have a diverse make-up

or if the group is homogeneous, then the individuals that make up the group must each have a high level of expertise. This is because "collective wisdom depends on the characteristics of the models people carry in their heads. For collective wisdom to emerge those models must be sophisticated, or they must be diverse."[73] Therefore, if it is not possible to pull together a team of subject matter experts to determine the best answer, which is often the case during the ever-changing landscape of war, then the military will be best served by allowing heterogeneous teams to determine which innovation is most likely to prevail.

Recommendations

To argue that it is currently unrealistic for military leaders to call upon their personnel for innovation, this paper has reviewed research beginning with the networks in the brain, to individual personality traits, to a more holistic view including leadership and organizational contributions (or detractions) to creativity and innovation. Likewise, the recommendations for how the military can reconcile its self-made obstacles to innovation are discussed from multiple levels. Although a particular recommendation may be primarily focused on one of these areas, it should be well understood at this point that the organizational culture, leadership, and individual creative contributions are intimately networked.

In order to have an innovative organization, the organization must have both creative personnel and an environment that supports their creativity (Figure 1). The military should actively recruit individuals with creative personalities that favor divergent thinking. Tools such the Creative Problem Solving Profile and the Torrance Tests of Creative Thinking can help identify those personnel.[74,75] Evaluation of potential recruits should also provide insight into whether creative personalities are self-selecting away from the military based on perceptions of an anti-innovation culture (this may be particularly important with today's "millennials"). If

innovators are actually joining the ranks, retesting them periodically may help identify if and how creative personalities are being repressed or supported within the military environment. Or even better, early identification should be used to vector creative personnel towards specific jobs or teams where their abilities will be best used.

The military trains in the manner it wants to fight. Regardless of whether or not individuals were creative when recruited, training in divergent thinking should be added to basic training and throughout Professional Military Education (PME). Any discussion of creative thinking by the PME system is almost always done in conjunction with "critical thinking"; this supports the typical military preponderance for convergent rather than divergent thinking.

Research has established that it is possible to train individuals to improve their divergent thinking. Meditation, including Integrative Body-Mind Training (IBMT) and Open-Monitoring (OM) mediation improves creative performance through improvements in divergent thinking.[76] [77] While many Western-minded military leaders might shrug off mediation as sitting and wasting time, they should instead consider how Sun Tzu's Eastern perspective might be used to prepare not only the battlespace but their warriors' minds as well.

In addition to allotting personnel time to improve their divergent thinking through training, military leaders must change their view on unscheduled time, or "white space", in the schedule. To think divergently, an individual must have time for the default network to incubate and give rise to the "a-ha moments" and novel concepts that can be developed into innovations. Scheduling twenty percent of time as "Google-time" may not be feasible during high-tempo operations (even though these may be the times innovation is most needed). Yet, while in garrison, leaders need to accept white space not as wasted space but as an investment in potential innovations.

Leaders have control over their personnel's time. They also have the power to create an environment that fosters creativity through empowering their people and supporting intrinsic motivation. The leaders are responsible for developing teams with the right diversity, teams that can identify problems and generate and evaluate novel solutions without succumbing to group-think. Additionally, military leaders must provide not just top-cover but the muscle to push and develop valuable creative ideas into actualized innovations.

Because so much of Figure 1 hinges on the leaders of a military organization, the last recommendation is to identify and promote innovative leaders. Innovative leaders are the ones who have a solid record of being creative themselves, in supporting creativity in their subordinates, and in helping drive innovation. Instead of being ostracized as rebels, these divergently thinking leaders should be supported, promoted, and allowed to groom the next generation of creative thinkers and innovators. As this cycle takes hold, the restraining check-list-driven norms will be replaced. Military culture will get comfortable with embracing "the strange" and be able to, realistically, expect military personnel to be creative and the organization to be innovative.

Conclusion

There are many historical examples of military members being creative and innovative, particularly during war and often when faced with life-or-death decisions. Their stories are inspirational. But why? They inspire us because they highlight feats of greatness. Creativity and innovation are not the norm, not in society at-large, and definitely not in today's military. The military calls for acts of innovation but continues to hold tight to a culture that requires marching in-step and ends up stamping out divergent thinking along the way. If innovation is the key to surprise, then the military must change. Military leaders must have the insight to

acknowledge the cultural constraints to creativity and be willing to breach the innovation-blocking barriers they find. By doing these things, they will reveal the path with unlimited ways to victory.

Notes

(All notes appear in shortened form. For full details, see appropriate entry in full bibliography)

[1] Gagliardi, *Sun Tzu's Art of War*, 116.

[2] Johansson, *The Medici Effect*, 14.

[3] Hunter, "Creative Cognition in the Workplace," 171.

[4] Carter, "Overcoming Creative Blocks," 71.

[5] Johansson, *The Medici Effect*, 15.

[6] Sawyer, *Explaining Creativity*, 15-17.

[7] Colzato "Prior Mediation Practice," 1.

[8] Joint Publication 1-02, 71.

[9] Runco, "Divergent thinking," 66-67.

[10] Stokes, "Variations on Guilford's Creative Abilities," 277-281.

[11] Vincent, "Divergent Thinking, Intelligence," 161-174.

[12] Csikszentmihalyi, *Creativity*, 93.

[13] Guilford, "Creativity," 444-446.

[14] Carter, "Overcoming Creative Blocks," p71.

[15] Stenberg, *Defying the Crowd*, 12.

[16] "The fMRI machine uses a magnetic field to detect the ratio of oxygenated to deoxygenated blood; each affects the magnetic field differently…When neuronal activation increases in a region of the neocortex, blood flow increases faster than the neurons can use the oxygen, causing the blood oxygen level dependent (BOLD) signal to increase." The measurements of the differences in BOLD signal provides information regarding activation or deactivation of particular brain regions. See Sawyer, "Cognitive Neuroscience of Creativity," 140.

[17] Ellamil, "Evaluative and Generative Modes," 1783-1794.

[18] Raichle, "Default Mode," 1086-1085.

[19] Mason, "Wandering Minds," 394-395.

[20] Ellamil, "Evaluative and Generative Modes," 1784.

[21] Liu, "Neural Correlates," 6.

[22] Dietrich, "Cognitive Neuroscience of Creativity," 1012.

[23] Ibid., 1011-1014.

[24] Ellamil, "Evaluative and Generative Modes," 1784.

[25] Fox, "The Wandering Brain," 612-615.

[26] Dietrich, "Cognitive Neuroscience of Creativity," 1016.

[27] Dietrich initially describes the prefrontal cortex as being comprised of the ventromedial prefrontal cortex (VMPFC) and the dorsolateral prefrontal cortex (DLPFC); however, he discusses the spontaneous and deliberate processing modes as occurring in the prefrontal cortex generically rather than specifying the particular regions. This might cause some confusion to the reader if they note that the medial prefrontal cortex (MPFC), which is shown as a constituent of the default network in Table 1, has the words "prefrontal cortex" within the name. fMRI research accomplished over the last nine years has significantly improved the understanding of the specific regions of the prefrontal cortex involved in the executive and default networks, which as discussed in the body of this paper are the DLPFC and the MPFC, respectively. Dietrich's discussion taken in light of the newer research provides excellent insight into the different creative roles played by different regions of the brain even if hind-site shows his use of the general term "prefrontal cortex" was too sweeping. See Dietrich, "Cognitive Neuroscience of Creativity," 1012-1018., Limb, "Neural Substrates," 3-5., and Fox, "The Wandering Brain," 612-617.

[28] Lui, "Neural Correlates," 1.

[29] Dietrich, "Cognitive Neuroscience of Creativity," 1015-1014.

[30] Sawyer, "Cognitive Neuroscience," 146.

[31] Ibid.

[32] Ibid.

[33] Dietrich, "Cognitive Neuroscience of Creativity," 1015.

[34] Ibid., 1016.

[35] Ibid., 1015.

[36] Ibid., 1016.

[37] Limb, "Neural Substrates," 1.

[38] Ibid., 1-9.

[39] Lui, "Neural Correlates," 1-8.

[40] Limb, "Neural Substrates," 4.

[41] Ibid., 5.

[42] Ibid., 4.

[43] Benedek, "To Create or Recall," 125.

[44] Ellamil, "Evaluative and Generative Modes," 1784.

[45] Ibid., 1787-1788.

[46] Ibid., 1790.

[47] Dietrich, "Cognitive Neuroscience of Creativity," 1016.

[48] Ellamil, "Evaluative and Generative Modes," 1791.

[49] Buckner, "The Brain's Default Network," 24.

[50] In his book "Adapt" Tim Harford chooses very particular words to describe how Col H.R. McMaster was perceived when he was working to pacify Tal Afar, Iraq. Harford describes McMaster as having "improvised one of the few successful responses…" and by doing so he ,"…short-circuited the chain of command…" and was told by senior officers to "…shut his big mouth and stop thinking above his rank." Harford emphasizes that McMaster, "…paid a price for his courageous independence…was twice passed over for promotion…His superiors focused not on his performance, but on what they saw as a troublemaker's attitude." This is an excellent example of the perceived consequences for a military member who improvises and goes against the cultural norm. Even if he is successful and saves lives, the organization may still punish him for thinking divergently. See Harford, *Adapt*, 59-60.

[51] Guilford, "Creativity," 444.

[52] Sternberg, *Defying the Crowd*, 8.

[53] Csikszentmihalyi, *Creativity*, 57-53.

[54] Da Costa, "Personal Factors of Creativity," 165-172.

[55] Ding, "Improving Creativity Performance," 1.

[56] Shepard, "Innovation-Resisting," 472.

[57] Ibid., 474

[58] Block, *Work Rules!*, 135.

[59] Kretkowski, "The 15 Percent Solution," 1.

[60] Dyer, *The Innovator's DNA*, 175-179.

[61] Gumusluoglu, "Transformational leadership," 461-462.

[62] Zhou, "Leading for Creativity," 23-24.

[63] Ozarralli, "Linking Empowering Leader," 374.

[64] The application of the military's operational concept of "mission command" should combat the smothering effect of close-control and support adaptability (creativity and innovation) through personnel empowerment. As described in Joint Publication 3-0, "Mission command is the conduct of military operations through decentralized execution based upon mission-type orders. Successful mission command demands that subordinate leaders at all echelons exercise disciplined initiative and act aggressively and independently to accomplish the mission." (See Joint Publication 3-0, II-3.) Commanders must relay their intent, what they believe needs to be accomplished, as well any other restraints or requirements, to their subordinate troops who then

are able to figure out the best way to meet the mission. As described, mission command should be supportive of creativity and innovation. Unfortunately, many argue it is not actually being practiced; there are too many cultural barriers to allow for true decentralized execution. These anti-creative barriers include some already described: cookie-cutter training and fear of disagreeing with unapproachable superiors. See Pryer, "Growing Leaders," 33-36.

[65] Sawyer, *Explaining Creativity*, 232.

[66] Hambrick, "Influence of Top Management," 665.

[67] Sawyer, *Explaining Creativity*, 232.

[68] Hambrick, "Influence of Top Management," 677-678.

[69] Sawyer, *Explaining Creativity*, 233-234

[70] Ibid., 234

[71] Ibid., 235.

[72] Ibid., 246.

[73] Hong, "Some Microfoundations of Collective Wisdom," 56-72.

[74] Kim, "Can We Trust Creativity Tests?" 3-5.

[75] Basadur, "Leading Others to Think Innovatively," 114-116.

[76] Colzato, "Prior Mediation Practice," 1.

[77] Ding, "Improving Creativity Performance," 7.

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