

Adaptability: Time to Start Thinking about Thinking

A Monograph

by

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Abstract

Adaptability: Time to Start Thinking about Thinking, by MAJ Cassandra Crosby, 42 pages.

The tendency to maintain familiar behaviors while evolving slowly and incrementally when faced with unfamiliar problems is the result of a gap in the US Army's understanding of adaptability and the conditions required to achieve it. Developing adaptive leaders is one of the Chief of Staff of the US Army's top priorities, yet few, if any, people seem to be talking about how to enable this critical capability. This monograph argues the US Army must foster "strength of the mind" at the individual level to enable the kind of adaptive behavior the Chief of Staff of the Army demands. Adaptability requires flexible, creative, unprejudiced, and reflective thinking; the thought patterns that enable cognitive agility. However, this kind of thinking is not something that merely happens in the mind. The interrelationship between mind, body and environment continuously and dynamically shapes the structure, functional organization, and connectivity of an individual's brain rendering them either more or less likely to sustain cognitive agility in both short-term and long-term contexts. Previous efforts to improve the Army's adaptability focused on institutional development. However, the US Army needs to do more than ask how it can inculcate adaptability through its doctrine and training programs. Rather, the question that requires further research is if the patterns in the Army's current culture and climate support the kind of thinking that enables adaptability at the individual level, or if its tendencies stifle flexible, creative, unprejudiced, and reflective thinking. The answer to this question will provide the impetus for the US Army to take steps toward actionable and enduring change.

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Acronyms

ADD	Attention Deficit Disorder
ADRP	Army Doctrine Reference Publication
ADT	Attention Deficit Trait
CSA	Chief of Staff of the Army
FM	Field Manual
TRADOC	Training and Doctrine Command
US	United States

Introduction

If our minds themselves can include aspects of our social and physical environments, then the kinds of social and physical environments we create can reconfigure our minds and our capacity for thought and reason.

— Andy Clark, *Supersizing the*

Mind

If we are to understand the mind as the locus of intelligence, we cannot follow Descartes in regarding it as separable in principle from the body and the world ... Broader approaches, freed of that prejudicial commitment, can look again at perception and action, at skillful involvement with public equipment and social organization, and see not principled separation but all sorts of close coupling and functional unity...Mind, therefore, is not incidentally but intimately embodied and intimately embedded in its world.

— John Haugeland, *Mind Embodied and Embedded*

The United States (US) Army has a tendency to maintain familiar behaviors while evolving slowly and incrementally when faced with unfamiliar problems. Robert Komer's 1972 study on the Vietnam War concluded that conventional government institutions struggled to respond optimally to the atypical problems it faced in Vietnam, prolonging the conflict.¹ Almost thirty years later, April 2003 news reports attributed military success in the war in Iraq to superior agility and adaptability. Newspapers quoted Dick Cheney as attributing the successful advance on Baghdad to "brilliant military planning;" but it was the military's ability to adapt quickly to changing circumstances that seemed to win the day.² At the time, it appeared the military had become significantly more agile and adaptive since the Vietnam War, but this was not the case. Not long after the initial news reports recounted the military's success, a growing resistance to the US presence amongst the Iraqi population began to bog down

¹ R. W. Komer, *Bureaucracy Does Its Thing* (Santa Monica: Rand, 1972), 151.

² Michael R. Gordon, "Adaptability and Agility Keys to Winning War," *Oakland Tribune*, 2003, accessed December 2, 2014, <http://search.proquest.com.lumen.cgscarl.com/docview/351874995?pq-origsite=summon>.

US forces in Iraq. A blue-ribbon panel of bipartisan, independent experts, appointed by Secretary of Defense Donald Rumsfeld in August 2004, found the military was slow to “adapt accordingly after the insurgency started in the summer of 2003.”³ In a mere matter of months, the military went from being an agile and adaptive force fighting a familiar threat, to one that was slow to evolve once the shape of that threat morphed into something unexpected, just as it had in Vietnam. Over the past decade, the US Army has attempted to improve its adaptability when faced with unfamiliar problems by developing and revising its doctrine and training, yet it continues to struggle.

Today, the US Army’s senior leaders are urgent in their demand for an adaptive force. On October 2, 2014, General Raymond Odierno, United States (US) Chief of Staff of the Army (CSA) addressed his top concerns for the future of the force saying, “We need an Army that can be adaptive, innovative, exploits the initiative, and can solve problems in many different ways.”⁴ Additionally, the 2014 Army Posture Statement lists developing adaptive leaders as one of the CSA and Secretary of the Army’s top priorities. As the posture statement suggests, future warfare will entail complex problem solving and require the Army to operate in a wide variety of environments, as they have throughout history.⁵

War in its contemporary context requires commanders to plan and synchronize operations which incorporate military, interagency, multi-national, and non-governmental forces in pursuit of goals and objectives in complex environments.

³ Thomas E. Ricks, “Rumsfeld’s War Plan Shares the Blame,” *The Washington Post*, 2004, accessed December 2, 2014, <http://search.proquest.com.lumen.cgsccarl.com/docview/409643714?pq-origsite=summon>.

⁴ Michelle Tan, “Army Chief Talks New Deployments; Grave Readiness Concerns,” *Army Times*, 2014, accessed February 19, 2015, <http://archive.armytimes.com/article/20141002/NEWS/310020078/Army-chief-talks-new-deployments-grave-readiness-concern>.

⁵ John M. McHugh and Raymond T. Odierno, *A Statement on the Posture of the United States Army, Fiscal Year 2014*, Posture Statement presented to the 113th Cong., 2nd sess. (Washington, DC: U.S. Department of the Army, 2014), 5.

However, Nineteenth Century German military theorist Carl von Clausewitz, wrote of the nature of war that “[t]he original political objects can greatly alter during the course of the war and many finally change entirely since they are influenced by events and their probable consequences.”⁶ Thus, the interaction of opponents in war drives the evolution of strategic aims and objectives as opposing forces continuously seek a position of relative advantage and effect change within the operational environment. Retaining coherence and maintaining persistence in this environment depends on extensive interactions between agencies, the aggregation of diverse elements in pursuit of common goals, and adaptation.⁷

Complexity theorists, Robert M. Axelrod and Michael D. Cohen, define adaptation as a process that “leads to improvements according to some measure of success.”⁸ In biological usage, William Fulmer, a senior fellow at the Harvard Business School, asserts adaptation is “the process whereby an organism fits itself to its environment.”⁹ In nature, when an organism faces change within its environment, it may have a temporary existence, but will eventually become extinct if it too does not evolve. However, evolution can lead to death if an organism does not also learn how to survive in its new environment.¹⁰ Once an organism adapts, it displays novel behavior which changes the context of the environment. This means other organisms within the environment then have to adapt as well, or risk extinction, a process called coevolution. Coevolution requires organisms to be able to see beyond their own terrain and exist

⁶ Carl von Clausewitz, *On War*, eds. Michael Howard and Peter Paret, (Princeton, N.J.: Princeton University Press, 1976), 92.

⁷ William E. Fulmer, *Shaping The Adaptive Organization* (New York: AMACOM, 2000), 59.

⁸ Robert M. Axelrod and Michael D. Cohen, *Harnessing Complexity* (New York: Free Press, 1999), 7.

⁹ Fulmer, 60.

¹⁰ Bruce Wallace and Adrian M. Srb, *Adaptation* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1961), 2-4.

comfortably poised between order and chaos; too much control and they will be too rigid to change with others, too little control and they will lack the ability to create order. Here, Fulmer argues that “the organism is orderly enough to ensure stability, yet full of flexibility and surprise.”¹¹ However, John Holland, a complexity theorist, ascribes this coevolution “to a kind of complexity that greatly hinders our attempts to solve some of the most important problems posed by our world,” such as those found in modern-day conflicts.¹²

Clausewitz characterizes war as the clash between wills - the limitless extremes of exertions. Clausewitz seems to have understood war at its most elemental level; as organisms interacting in nature, suggesting war consists of humans competing, learning, and trying to survive in dynamic and rapidly changing environments.¹³ Just as in nature where “well adapted individuals may be killed accidentally while their less adapted neighbors escape by luck,” success in war can also be a matter of chance.¹⁴ Clausewitz cites the elements of war as danger, exertion, uncertainty, and chance. He argues that “[f]ortitude of mind and character are required to make progress in these impeding elements with safety and success” if one is to overcome the challenges of complexity.¹⁵ Though the complex nature of war presents a challenge to the force, humans have an advantage over mere organisms which, as Clausewitz suggests, exists in the power of the mind.

The US Army must foster a “strength of the mind” at the individual level to enable the kind of adaptive behavior the Chief of Staff of the US Army demands.

¹¹ Fulmer, 50-52.

¹² John H Holland, *Hidden Order* (Reading, MA.: Addison-Wesley, 1995), xviii.

¹³ Clausewitz, 75-77.

¹⁴ Bruce Wallace and Adrian M. Srb, *Adaptation* (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1961), 2-4.

¹⁵ Clausewitz, 104.

Systems theorist Peter Senge argues an organization's aptitude for learning - and therefore adaptability - can be no greater than that of its individual members.¹⁶

Adaptability requires *cognitive agility*, a state of mind enabled by flexible, creative, unprejudiced, and reflective thinking. Cognitive neuroscientist Dr. Wilma Koutstaal asserts cognitive agility,

Involves representing and processing (using) information and knowledge that is flexibly, creatively, and adaptively attuned to changing circumstances and goals. It is thinking that is able to promote and sustain both long-term and provisional plans and projects in the face of dynamic and more stable environments, in the midst of uncertainty and ambiguity, and real-life risks and rewards.¹⁷

However, this kind of thinking is not something that merely happens in the mind. The environments in which “we live, work, and play continuously and dynamically shape the structure and functional organization and connectivity of our brains - and render us either more or less likely to sustain agility of mind both in immediate or shorter term contexts[.]”¹⁸ Therefore, harnessing the strength of the mind requires more than simply treating the symptoms of sluggish adaptation with short-term solutions. The US Army needs to do more than institutionalize adaptability through its doctrine and training programs; it also needs to set conditions within its culture and climate to enable the kind of thinking that allows adaptive behavior and effective problem solving to occur.

To do this, the Army must first consider the kind of thinking that allows an individual to gain understanding and adapt in complex and unfamiliar environments. Then, the Army must consider the factors that inhibit or enhance these patterns of thought. This monograph approaches these considerations using a qualitative method to identify the thought patterns that enable adaptive behavior. The research is limited to qualitative methods and relies on empirical evidence and findings from quantitative

¹⁶ Peter M. Senge, *The Fifth Discipline* (New York: Doubleday/Currency, 1990), 7.

¹⁷ Wilma Koutstaal, *The Agile Mind* (Oxford: Oxford University Press, 2012), 3.

¹⁸ *Ibid.*, 571.

research conducted by experts of various disciplines to overcome this limitation. Owing to the scope of this monograph, the research seeks to understand adaptability from an individual perspective as it relates how one thinks and how environment influences thinking, rather than looking at it from an institutional perspective. Furthermore, the scope of the study does not seek to determine if the current climate or culture of the US Army inhibits or enhances cognitive agility, but establishes a framework for further discussion, instead. The factors presented that inhibit or enhance cognitive capacity for certain types of thinking are not “all-inclusive” as the research intends to generate a desire for further research, rather than recommend actionable solutions.

Section one of this monograph is a literature review which highlights a gap in the US Army’s current understanding of how adaptive behavior occurs. This section addresses how cognitive theorists define agility of the mind and provides a brief review of a selection of theories on how the brain works to establish a gap between cognitive theory and the US Army’s assumptions about how adaptability occurs. Section two discusses thinking in complexity to establish a link between effective thinking in complex situations and cognitive agility. This section provides an understanding of complexity theory, systems thinking, and cognitive theory to establish a theoretical framework for the type of thinking required to gain understanding and frame problems in complex environments. It describes the way systems theorists suggest people need to think in complex scenarios and analyzes perspectives from multiple disciplines in order to establish a comprehensive definition of cognitive agility.

Section three of this monograph addresses making and breaking the brain paths to cognitive agility in order to demonstrate the role of culture and climate in an individual’s capacity for certain thought patterns. This section is broken into three subsections analyzing the interrelationship between mind, body, and environment in thinking in order to determine specific factors that serve to inhibit or enhance cognitive agility. The first subsection discusses heuristics and the influence of mental models on an individual’s ability to generate hypothesis and define problems. The second

subsection presents a phenomena called functional fixedness, which can serve as a cognitive barrier to creativity. The third subsection provides an overview of work design and analyzes the way in which an individual's work environment impacts thinking. Section four, the final section of this monograph, provides an analysis of the research, concludes the study, and suggests further research.

Section One: Literature Review

This section justifies the study and provides a review of some of the literature used in the research. The review juxtaposes current US Army doctrine with literature on cognitive theories to highlight the US Army's historical and contemporary misunderstanding of the way in which adaptive behavior occurs. It also provides a brief overview of some of the previous research aimed at improving the Army's performance through institutional changes. The intent of the review is to reveal a gap in the US Army's understanding of adaptive behavior and the conditions required to achieve it.

US Army doctrine falls short in its discussion on adaptability. It outlines rules leaders should use to guide their behavior and suggests following these rules will improve a leader's ability to "operate in constantly changing environments."¹⁹ However, doctrine appears to neglect considering how the mind works and the brain's limitations in regard to deliberately changing behavior. According to Field Manual (FM) 6-22, *Leadership Development*, to be more adaptive, leaders are supposed to learn to adapt by adapting, lead across cultures, and seek challenges. This doctrine also suggests that "[i]n a strategic environment of extreme complexity, ambiguity, and volatility, strategic leaders must think in multiple time periods and apply more adaptability and agility to manage change."²⁰ Koutstaal identifies the kind of conscious modification in thinking suggested by the Army's leadership development doctrine as set shifting. Set shifting

¹⁹ Field Manual (FM) 6-22, *Leadership Development* (Washington, DC: Government Printing Office, 2006) v.

²⁰ Ibid., 12-1.

requires an individual to consciously alter the rules they normally use to guide their behavior, but does not appear to be an activity which an individual can control deliberately.²¹

A psychological study by Andrew B. Leber and associates links improved set switching to increased cognitive flexibility and improved set reconfiguration, or reframing of the problem. Leber concluded that people are largely unable to adjust their behavior on cue “despite detailed feedback and motivational payoff schemes.”²² By this standard, doctrine falls short in recognizing how leaders overcome deficiencies in their thinking. For example, leading across cultures involves more than just an individual having experience in Iraq and/or Afghanistan. It means also having opportunities to serve within various subcultures of the Army, and engaging and leading with allied, coalition, and other partner nations. Without the requisite experience these opportunities provide, an individual cannot deliberately alter thinking, even if compliance means the individual will receive a promotion or increased levels of responsibility.

Another gap in the Army’s understanding of the way in which thinking occurs, and arguably the most critical, is found in the phrase “agility assists thinking[.]”²³ This assumption contradicts Koutstaal’s findings which determined the opposite is true; better thinking actually enables cognitive agility. According to Koutstaal, mental agility occurs as the interaction along two interdependent dimensions. The first dimension corresponds to the process, or the way in which thinking occurs. Koutstaal refers to this dimension as the continuum of cognitive control which ranges from deliberate and controlled, to spontaneous or improvisational, responding and thinking. The second dimension corresponds to the content of thought or the subject to which one directs

²¹ Koutstaal, 359-360.

²² Andrew B. Leber, Nicholas B. Turk-Browne and Marvin M. Chun, “Neural Predictors of Moment-to-Moment Fluctuations in Cognitive Flexibility,” *Proceedings of the National Academy of Sciences* 105, no. 36 (2008): 13595.

²³ FM 6-22, 6-1.

thinking. This dimension is the continuum of mental representation in which thought ranges from highly abstract, to exceedingly specific. According to Koutstaal, an agile thinker navigates along these two continuums simultaneously and, “communicates rich and complex meaning through simple and concise form and can achieve disproportionately effective results from a deceptively simple action.”²⁴ Thus, the Army appears to have it backward; it is the convergence of multidimensional thinking and the ability to construct a multitude of mental representations which enables cognitive agility, not cognitive agility which enables thinking.²⁵

The Army’s struggle to become more adaptable is largely a result of its assertions about how thinking occurs. Army doctrine suggests mental agility is one way leaders can be more adaptable and defines it in leadership development doctrine as a “flexibility of the mind.”²⁶ To achieve this flexibility, doctrine outlines a series of tools for becoming adaptable calling them a collection of thought habits including: open-mindedness, ability to consider multiple perspectives, not jumping to conclusions, willingness to take risks, and being resilient to setbacks.²⁷ These common characteristics identify how adaptive leaders act, but an individual who does not inherently display these characteristics will not be able to consciously modify their behavior. These prescriptive solutions are yet another case of suggested “set shifting” in which the Army fails to identify how to set conditions for this kind of thinking to occur.

The Army describes adaptability as a deliberate behavior in which an individual behaves to comply with the common characteristics outlined in doctrine. However, this doctrinal construct is counterintuitive to evidence of how the mind works. The founder

²⁴ Charles Forceville, Kurt Feyaerts and Tony Veale, *Creativity and the Agile Mind* (Berlin: De Gruyter, 2013), 16.

²⁵ Koutstaal, 4.

²⁶ FM 6-22, 6-1.

²⁷ Ibid., 10-9.

of the Society for Organizational Learning, Peter M. Senge, suggests mental models influence perception and behavior through “deeply ingrained assumptions, generalizations, or even pictures or images.”²⁸ An individual is often not consciously aware of these unconscious mental models or their effect on behavior. To overcome these models, Senge suggests one must “turn the mirror inward; learning to unearth our internal pictures of the world, to bring them to the surface and hold them rigorously to scrutiny.”²⁹ Otherwise, mental models will take precedence over an individual’s conscious attempts to avoid hasty conclusions or consider multiple perspectives.

Koutstaal asserts that one can find the thought patterns necessary to overcome mental models through cognitive agility. These thought patterns are a cerebral voyage between abstract and concrete thoughts; thinking in details and big picture; practicing controlled and automatic thinking, zooming in and out to distort perception, keeping feelings and thoughts either connected or disconnected when needed, and regulating between attention and distraction.³⁰ However, she further asserts that this voyage is *interdependent* with the brain’s ongoing interaction with mental, physical and social environments. According to Koutstaal, “crucial and continual interfacing with the broader environment creates brain paths to agile thinking,” but it can also inhibit one’s ability to discover those paths.³¹ Thus, enabling cognitive agility in an effort to overcome mental models requires a consideration of how one’s environment impacts one’s capacity for specific patterns of thought.

Previous research on improving the Army’s adaptability focuses on an organizational perspective, and typically suggests institutional changes. In 2009, Colonel Glenn K. Grothe conducted a study on how the Army can produce adaptive

²⁸ Senge, 8.

²⁹ Ibid.

³⁰ Koutstaal, 29-30

³¹ Ibid., 337

leaders and concluded with recommendations for change in a number of areas. He asserts leaders need to foster an environment that enables decentralized adaptation or innovation within their existing organizational structures and minimize a zero-defect environment. He also suggested the Army should relook its intermediate level education to focus on generating critical thinkers to solve complex problems.³²

US Army Major Joseph H. Albrecht conducted a similar study in 2010, but looked at the Army's need for adaptive leaders at the junior officer level, based on the complexity of the current environment. He suggested the Army should pursue adaptive leader development at the pre-commissioning phase of officer education through "experience-based" approaches. His conclusion asserted that experiential learning opportunities in the classroom provided by the Adaptive Course Model and small group instruction would achieve a balance between education and training and develop adaptive leaders.³³ Both studies focused on changes the institutional Army could undertake to relieve symptoms of a larger problem, but these modifications did not take a holistic approach to the Army's fundamental struggle to become more adaptive.

This monograph differs in its approach to adaptability in that it seeks to understand how thinking occurs on an individual level. Rather than focusing on how someone who is adaptive acts or how institutional methods foster adaptability, the research focuses on determining how environmental conditions influence capacity for certain patterns of thought at the individual level. First, the research explores cognitive agility as it relates to complexity in order to link multidimensional thinking to the ability to frame problems and generate options in the contemporary context. Next, it focuses on factors that affect thinking in order to shed light on how culture and climate can impact

³² Glenn K. Grothe, "Innovation Versus Adaptability: Seizing the Initiative Through Creative Thinking Versus Reacting to the Enemy" (Masters, United States Command and General Staff College, 2009), 41-47.

³³ Joseph H. Albrecht, 'Understanding and Developing Adaptive Leadership During Pre-commissioning' (Masters, United States Command and General Staff College, 2010), 76-79.

an individual's cognitive agility through an individual's interaction with the environment. It addresses unconscious cognition - which in most psychology texts is interchangeable with subconscious - to demonstrate the impact of automatic cognitive processes on an individual's attempts to contend with unfamiliar and uncertain environments. Unconscious cognition influences the way an individual perceives information, is a difficult pattern to revise, and creates barriers to flexible and unprejudiced thought. Finally, research intends to reveal how an individual's mind, body, and environment interact to inhibit or enhance that individual's capacity for flexible, creative, unprejudiced, and reflective patterns of thought. This monograph intends to demonstrate how asking the right questions can reveal long-term solutions to creating an organization that encourages and rewards better thinking, and ultimately, do what President John F. Kennedy urged in a commencement address to Yale University in 1962, "develop sophisticated solutions to complex and obstinate issues."³⁴

The literature reviewed throughout the research for this monograph seems to suggest the US Army has a behaviorist perspective on adaptability which views thinking as a more "mechanistic behavior which just happened to go [on] inside the head."³⁵ The behaviorist perspective was one of the earliest theories on thinking and was quite basic, failing to acknowledge thinking as occurring from the interrelationship between mind, body, and environment. Contemporary cognitive theorists suggest the cognitive processes that enable adaptability are more complex than the Army depicts in doctrine. Both conscious and unconscious thought processes operating across multiple dimensions are required to gain understanding and solve problems in complex environments, but those processes risk interference from both external and internal factors.³⁶ Without

³⁴ Donald A Schön, *The Reflective Practitioner* (New York: Basic Books, 1983), 6.

³⁵ Bryan Lawson, *How Designers Think* (London: Butterworth Architecture, 1990), 131.

³⁶ Koutstaal, 7

changing the way it thinks about thinking, the US Army will continue to repeat the behaviors of the past, which will prevent it from becoming the adaptive force it desires.

Section Two: Thinking in complexity

The previous section highlighted a gap in the Army's understanding of adaptability based on research from cognitive theorists on how the brain works. Complexity theory, systems theory, and cognitive theory serve as the theoretical frameworks for the research in this section. Thinking in complexity provides an overview of complexity theory, the challenges it presents, and how one must think to gain understanding and adapt in the contemporary context. Then, it lays the framework for a multidisciplinary perspective on the kind of thinking indicative of cognitive agility which enables adaptive behavior in dynamic and complex environments.

War is inherently complex; it is unpredictable, and regardless of the mode in which it is fought, occurs in dynamically changing environments.³⁷ Even though people often turn to terms like “uncertain” and “ambiguous” when dealing with complexity, ambiguity itself is a derivative of one's own perception. Individuals see the world as complex because they lack adequate concepts to explain it.³⁸ In the contemporary environment, the evolution from state-on-state conflict to the rise of non-state actors, has resulted in numerous unknowns for the Army both in current operations and while attempting to visualize future warfare challenges. The current US Army Operating Concept suggests that “[c]hanges in technology and geopolitical dynamics as well as the enduring political and human nature of war will keep war in the realms of complexity and uncertainty.”³⁹ Further exacerbating the uncertainty in war is the element of time.

³⁷ Frank J. Hoffman, “Hybrid Warfare and Challenges,” *Joint Forces Quarterly*, no. 52 (2009), 43-49.

³⁸ Jamshid Gharajedaghi, *Systems Thinking*, 2nd ed. (Burlington, MA: Butterworth-Heinemann, 2006), 25.

³⁹ Training and Doctrine Command (TRADOC) Pamphlet 525-3-1, *Army Operating Concept*, (Washington, DC: Government Printing Office, 2014), 8.

An army never knows how much time it has to prepare for the next conflict, until the next conflict occurs.⁴⁰ Solving problems in this uncertain and emergent environment may cause a cognitive quagmire for someone who is linear or rigid in her thought processes, but the flexible, creative, unprejudiced and reflective thinker will find comfort in the unknown and seize opportunities to explore unexpected choices.⁴¹

Determining the thought patterns essential to adaptability in modern-day conflict requires an understanding of complexity. Complexity theory provides the lens with which to understand the current operating environment, and also sets the stage for systems thinking; a multi-faceted type of thinking vital to framing and solving complex problems. The basis of complexity theory is that the parts of a system interact repeatedly, spontaneously organizing in an unpredictable pattern of behavior. Everett Carl Dolman asserts that systems, “use simple rules or behavioral guides and may self-organize to form a structure that exhibits emergent characteristics or properties that cannot be predicted on knowledge of those interactions alone.”⁴² Axelrod and Cohen assert complex systems are unpredictable as the forces, “shaping the future do not add up in a simple, system-wide manner.”⁴³ Changes in one variable can affect the status of many other interrelated variables making it difficult to anticipate all possible consequences of any one action.⁴⁴ Therefore, a single event can have grand effects, such as the unethical actions of an individual soldier in a war zone inciting public backlash, greatly changing the trajectory and nature of the war. Thus, in a complex system, systems theorist Robert Jervis suggests, “the chains of consequences extend over time

⁴⁰ TRADOC Pamphlet 525-3-1., 49.

⁴¹ Forceville, et al., 27.

⁴² Ibid., 115.

⁴³ Axelrod and Cohen, 14-15.

⁴⁴ Deniz Eseryel, Dirk Ifenthaler and Xun Ge, “Towards Innovation In Complex Problem Solving Research: An Introduction to the Special Issue,” *Education Tech Research Dev* 61, no. 3 (2013): 359-363.

and many areas: the effects of action are always multiple.”⁴⁵

Understanding a system by disaggregating its parts to perform categorical analysis is impossible; meaning of the whole cannot emerge from a consideration of the individual parts alone. Emergent properties are the spontaneous outcomes of the interacting parts of a system, manifested as collective, and specifically purposeful, behavior.⁴⁶ Systems theorist Robert Johnson considers systems emergent when “local interactions result in discernable macro-behavior,” or patterns.⁴⁷ However, these patterns emerge from the system as a whole, not the individual parts.⁴⁸ For example, a clock is a system of interacting parts; the sole function to keep time. The human capacity to tell time and distribute that information to other humans, is a socially emergent characteristic of a multi-minded -or social- system. One can recognize emergent behavior by the patterns that appear in the interaction between humans and machines in the breeding of routines.⁴⁹ However, just knowing a clock keeps time or that a human can tell time is not adequate to gain understanding of these patterns.

Purpose, or common objectives and collectively acceptable ways of pursuing those objectives, provides cohesion in a multi-minded system, whether it be a state, a non-state entity, or other socially constructed organization.⁵⁰ When the context of a system’s environment changes, as it inevitably will, the effects will have far-reaching consequences.⁵¹ However, adaptation is a behavior modification which allows the

⁴⁵ Robert Jervis, *System Effects* (Princeton, NJ: Princeton University Press, 1997), 10.

⁴⁶ Ibid.; Gharajedaghi, 48.

⁴⁷ Johnson, *Emergence*, 18. Macro-behavior refers to patterns in action and behavior as well as patterns that continue over time.

⁴⁸ Axelrod and Cohen, 15.

⁴⁹ Dolman, 115.

⁵⁰ Gharajedaghi, 13.

⁵¹ Jervis, 10.

system to continue to pursue its intended purpose when faced with change, lest it cease to exist. This adjustment in behavior requires learning, an iterative process, in which an individual or organization develops different, more appropriate, and even counterintuitive methods to survive in the face of rapid change.⁵² Adaptation is initially a display of rudimentary intelligence in a system, but over time and multiple adaptations, Dolman suggests, “the system learns.”⁵³ Axelrod and Cohen use the term complex adaptive system for a system containing agents who *seek to learn*, like most multi-minded systems.⁵⁴ It is the ability of the parts to learn that separates complex adaptive systems from other systems, and learning which enables adaptation.

Understanding feedback in a systems context is important as the Army seeks adaptive leaders. Adaptability requires an individual to think in terms of feedback loops, rather than linear patterns in complex environments. Thinking in terms of feedback loops allows an individual to see reciprocal flow of influence, rather than seeing a one-directional flow of influence where individual actions influence only the intended recipient and not the individual, in return. Envisioning the reciprocal flow of influence enables the anticipation of second and third order effects and the consideration that acting on a system changes the system.⁵⁵ Therefore, pursuing goals in a complex environment requires a continuous process of assessment and learning, which an individual can only effectively accomplish with an understanding of feedback in a complex adaptive system.

Complexity theorist Steven Johnson argues that for a social system to adapt, most of the time learning involves, “tinkering with different kinds of feedback.”⁵⁶ All

⁵² Koutstaal, 276.

⁵³ Dolman, 114.

⁵⁴ Axelrod and Cohen, 7-8.

⁵⁵ Senge, 74-75.

⁵⁶ Johnson, 137.

conscious behavior results in some form of feedback, either negative or positive, because of the densely interconnected variables within a complex adaptive system. One can understand negative feedback through the standard concept of a thermostat, a system which uses negative feedback to achieve an equilibrium in temperature in an enclosed space. Most home thermostats circulate between hot, cool, and off, in a negative feedback loop which maintains the home at the desired temperature.

Negative feedback pushes a complex system toward its intended purpose. As a process, Johnson suggests negative feedback entails “comparing the current state of a system and the desired state of a system, and pushing the system in a direction that minimizes the difference between the two states.”⁵⁷ Each time the environment changes, negative feedback pushes a complex adaptive system to adjust its behavior back to a point of equilibrium in the new context, allowing the system to learn and continue in pursuit of its intended purpose.⁵⁸ In an organization, dialogue serves as a mechanism for individuals to develop a richer understanding of the changing environment while discussion results in decisions that aim to push the organization back toward its intended purpose. Dialogue and discussion enable individual learning but also organizational learning and adaptation; the outcome of which is an emergent property of the collective behavior of the organization’s members, and the nature of a complex adaptive system.⁵⁹

While negative feedback keeps the behavior of a system within a margin of error of a specific goal, positive feedback allows it to go beyond the goal. Positive feedback amplifies successive input signals, but does not return the system to a state of equilibrium. Instead, systems theorist Dietrich Dorner, argues, “positive feedback tends to undermine the stability of a system, and a system in which many variables are

⁵⁷ Johnson, 140.

⁵⁸ Ibid., 138.

⁵⁹ Senge, 230-31.

regulated by positive feedback can easily go haywire.”⁶⁰ Positive feedback results from the uncontrolled interaction between variables, while negative feedback Johnson argues, “is a way of reaching an equilibrium point despite unpredictable – and changing – external conditions[...] It is, in other words, a way of transforming a complex system into a complex adaptive system.”⁶¹

Complexity theory demonstrates the need for specific thought patterns when pursuing goals and objectives in contemporary conflicts. These conflicts occur in complex environments where interacting opponents learn and adapt through feedback loops generated by interaction amongst themselves and with each other. Gaining understanding and solving problems in these environments requires leaders who are attuned to the nature of complex adaptive systems and who are able to use the kind of thinking that allows them to generate novel options to thrive in novel contexts.

Gharajedaghi argues how one must think about systems to “manage chaos and complexity.”⁶² He asserts five principles act together as an interactive whole and define the essential characteristics and assumptions about the behavior of a multi-minded system: openness, purposefulness, multidimensionality, emergent property, and counterintuitiveness. Openness means one can only understand the behavior of the living system within the context of its environment.⁶³ Though the parts of a system interacting influences a system, it is also influenced by external factors. This speaks to what Axelrod and Cohen refer to as, “the large number of highly inter-connected variables affecting the problem state.”⁶⁴ In terms of purposefulness, every system has a

⁶⁰ Dietrich Dörner, *The Logic of Failure* (Reading, MA: Addison-Wesley Pub., 1997), 74.

⁶¹ Johnson, 138-39.

⁶² Gharajedaghi, 25.

⁶³ Ibid., 30.

⁶⁴ Axelrod and Cohen, 14.

purpose and to understand the system, one must know why the actors within the system do what they do which, to the outside observer, is not always obvious and as an emergent property, is not predictable.

Multidimensionality is most likely, “one of the most potent principles of systems thinking.”⁶⁵ The basis for multidimensionality is that one must be able to see beyond the relationship between paradoxes; the tendency to see two extremes in isolation rather than as part of a larger whole.⁶⁶ An example of a paradox is one cannot be happy if one is sad, but these two emotions are really part of an overall state of being, controlled by the body and mind, according to Johnson, as a “feedback-regulated homeostatic system.”⁶⁷ Therefore, one cannot view the two extremes in isolation to determine an individual’s overall mood. When Gharajedaghi wrote of emergent properties he recommended a systems thinker view a system in terms of “*becoming*” rather than merely in terms of “*being*.”⁶⁸ One must see the potential in a system and recognize the unpredictability of what it is to become as the spontaneous byproduct of ongoing interactions within the system. Finally, counterintuitiveness is an understanding, Gharajedaghi asserts, that, “actions intended to produce a desired outcome may, in fact, generate opposite results.”⁶⁹ Acting in a system changes the system and one must therefore view the system in whole, rather than in part, to see the effect of one’s actions and anticipate future outcomes.

As the individual actors in a complex adaptive system continually revise their

⁶⁵ Gharajedaghi, 38.

⁶⁶ Ibid., 39.

⁶⁷ Johnson, 141.

⁶⁸ Gharajedaghi, 48.

⁶⁹ Ibid., 49.

rules for interaction, those actors become embedded in perpetually novel surroundings.⁷⁰ To adapt to novel surroundings, these actors must either apply preexisting information to a new context or find a novel way to continue to excel in the new context by experimenting with creative ways to generate feedback in the system.⁷¹ Cognitive agility, which is comprised of the thought patterns that enable an individual to determine if a conventional or old approach is best or if a fresh approach is required, supports this process.⁷² Koutstaal defines adaptive thought in her theory of mental agility as thought which “requires movement between highly controlled thinking and less controlled or automatic thinking.”⁷³ Highly controlled thinking is deliberate, intentional, goal-guided, or systematic while automatic thinking is nondeliberate, nonintentional, habituated, or intuitive. These thought patterns “often occur in a broad, not sufficiently understood intermediate zone, near and straddling the center point, that involves spontaneous fluidity, improvisation, and creative ‘practice beyond the rules.’”⁷⁴ Koutstaal’s definition, suggests a multidimensionality of thought, both conscious and unconscious, which must occur to allow an individual to recognize when a behavior is inappropriate to a given situation and determine the behavior modifications required to thrive.

Gharajedaghi and Koutstaal provide two varying perspectives on thinking in complexity, yet they appear to agree that the kind of thinking required to gain understanding and solve problems in a complex adaptive system involves multidimensionality, finding comfort in the unknown, and learning. For the purposes of

⁷⁰ John H. Holland, “Complex Adaptive Systems,” *Daedalus*, 121 (Winter, 1992): 20.

⁷¹ Marci S. Decaro, Mareike Wieth, and Sian Beilock, “Methodologies For Examining Problem Solving Success And Failure,” *Methods* 42, no. 1 (2007): 58.

⁷² Koutstaal, 5.

⁷³ *Ibid.*, 50.

⁷⁴ *Ibid.*

this monograph, Gharajedaghi and Koutstaal's theories provide a framework for the initial understanding of the thought patterns that enable adaptive behavior in complex environments. However, a multidisciplinary perspective provides a more holistic basis for the flexible, creative, unprejudiced, and reflective thought patterns required to adapt and act in a continually novel context. These thought patterns comprise cognitive agility, a key enabler of adaptive behavior.

Creative thought patterns allow new perspectives to emerge as well as never before considered perspectives; one essential component of adaptive behavior.⁷⁵ In a multidisciplinary study, cognitive theorists Charles Forceville, Kurt Feyaerts and Tony Veale assert creativity not only “delivers surprising solutions to a problem, but also changes the way we view the problem itself.”⁷⁶ Flexible thought allows an individual to test multiple hypotheses and integrate multiple ideas while consciously filtering out unsuitable solutions to achieve an appropriate outcome. An individual whose thinking is flexible, approaches problems in multiple ways and develops problem solving strategies that circumvent the impact of her previous experience or biases.⁷⁷ Unprejudiced thinking is essential to exploring alternative solutions without eliminating alternatives before one has given each of them adequate and careful consideration. The suspension of judgment allows for a systematic evaluation of options and alternative solutions developed through flexible and creative thinking.⁷⁸

Adaptation is not possible without reflection, which design theorist Donald Schon suggests is an iterative process in which, “our thinking serves to reshape what we

⁷⁵ Forceville, et al., 29, 61.

⁷⁶ Ibid., 20.

⁷⁷ Decaro, et al., 58.

⁷⁸ Ernest R. Alexander, “Design in the Decision-Making Process,” *Policy Sciences* 14, no. 3 (1982): 282.

are doing while we are doing it.”⁷⁹ As a continuous transaction with the situation, reflective thought involves contemplating both retrospectively, into the past, and prospectively, into the future, to determine if past experiences and perceptions align with current reality and future desires.⁸⁰ That is to say, reflection serves as a check and balance, either tacit or deliberate, between perception and reality, and enables learning while doing. This constant self-observation and critique can answer questions such as: Is what I expected to happen actually happening? Were the premises for my actions correct? Do I need more information? Do I need a different course of action? Do I need to reframe the problem?⁸¹

People tend to follow pre-established practices for efficiency’s sake, but when those practices are no longer appropriate to the situation, Forceville, Feyaerts and Veale argue, flexible and creative thought patterns allow an individual to “strike out in a new direction” while unprejudiced thinking enables experimentation without bias.⁸² Reflection allows an individual’s tacit understandings and repetitive practices to surface, so he can criticize them in the current context and “make new sense of situations of uncertainty or uniqueness which he may allow himself to experience.”⁸³ These thought patterns together, and in unison, are a complex adaptive system that makes the brain paths for cognitive agility, from which adaptive behavior emerges.

Forceville, Feyaerts, and Veale also suggest the utility of cognitive agility in adaptive behavior, referring to it as mental or conceptual agility and define it as a

⁷⁹ Donald A Schön, *Educating the Reflective Practitioner* (San Francisco: Jossey-Bass, 1987), 26.

⁸⁰ Mara Sophia Zanutto, Lynne Cameron and Marilda C. Cavalcanti, *Confronting Metaphor in Use: An Applied Linguistic Approach* (John Benjamins Publishing Company, 2008), 291.

⁸¹ Dörner, 46.

⁸² Ibid., 45.

⁸³ Schön, *The Reflective Practitioner*, 61.

flexible metaphor:

We take it to signify a whole range of related abilities and qualities, such as: the ability to construe an object or situation in unconventional ways; the ability to perceive opportunistic ambiguity where others see only a conventional form or are overwhelmed by indeterminism; the ability to perceive unconventional affordances in an object or resource; ability to dynamically alter one's goals and the criteria guiding one's search state space; the ability to alter one's representation of an object or a problem; the ability to exploit ambiguity to achieve multiple goals at once, and thereby achieve a degree of conceptual and communicative economy; and so on.⁸⁴

The continuous practice of a cognitive duality between form, function, and meaning in pursuit of non-obvious ends results in cognitive agility.⁸⁵ In this mental state, flexible, creative, unprejudiced, and reflective thinking enables an iterative process of searching, solving, applying, and assessing in complex and dynamically changing environments.

History provides a window with which to view the results of the US military's failure to adapt in a complex system. The operating environment in Vietnam in 1965 was similar to the kind of environment the military faces today, given its complexity. When the United States went to war with North Vietnam in 1965, the US strategic aim was to send a message to communist regimes by defeating the nationalist movement in South Vietnam.⁸⁶ At the time, counterinsurgency was not a codified concept and the United States military, specifically the Army, entered the Vietnam War with a doctrine suited to conventional war in Europe. Senior leaders were convinced that with their mobility and firepower, they could easily defeat the Viet Cong. The conditions on the ground quickly invalidated the military's assumptions. The military found itself interacting with irregular forces who posed a much greater challenge than the conventional fight for which they were prepared.⁸⁷ Counterinsurgency theorist John

⁸⁴ Forceville, et al., 29.

⁸⁵ Ibid, 29.

⁸⁶ Joe Allen, *Vietnam* (Chicago, Ill.: Haymarket Books, 2008), 39-40.

⁸⁷ John A Nagl, *Learning to Eat Soup with a Knife* (Chicago: University of Chicago Press, 2005), 115-16, 152.

Nagl asserts, the irregular forces, the Viet Cong, learned quickly and adapted to American conventional tactics by modifying its own tactics to “preclude the use of close air support and artillery strikes.”⁸⁸ Meanwhile, the US Army only increased its focus on firepower, insisting on fighting a conventional war, rather than adapting to the war in which they found themselves. The US government never achieved its strategic aims, in part, due to its fixation on conventional warfare.

The “Pan Am Syndrome,” – a theory on adaptation – suggests adapting only gradually to a changing environment can lead to a disaster if the adaptation is to a deteriorating environment. An organization will bleed to death if it merely evolves to an imperceptible gradual change; always doing too little too late. Gharajedaghi explains this theory suggesting that “[b]y the time an organization recognizes the severity of the problem, it may already have lost most of its strength and be unable to do anything about it.”⁸⁹ In Vietnam, the mental models and fixations of the individuals within the US Army was one of the reasons for failure. By the time the United States realized it had a problem, it had lost its ability to effectively solve it; the government no longer had the support of the American people and Vietnam became a strategic quagmire. The United States completely withdrew from Vietnam in 1975, allowing the communists to achieve their strategic aims by expunging the will of the United States to continue fighting; a failure which hung over the United States and its military for decades.⁹⁰ Clearly, the US Army lacked the kind of thinking that allowed it to learn and adapt over two decades of escalating conflict.

Much like Vietnam, opponents in contemporary conflict display the behavior of complex adaptive systems, “dynamically interacting in multiple ways, following local

⁸⁸ Nagl, 155.

⁸⁹ Gharajedaghi, 55.

⁹⁰ Allen, 204-05.

rules” to “create higher-level behavior well suited to [their] environment.”⁹¹ Rather than being driven by mere military logic to achieve a decisive military outcome, contemporary campaigns require the US Army to closely link military objectives with strategic aims; aims which evolve as opponents continuously vie for a position of relative advantage.⁹² The use of armed force in this environment can be used both in the traditional sense, to establish military conditions for a political solution, as well as to seek political, as opposed to specifically military outcomes.⁹³ Dorner argues that “contradictory goals [objectives] are the rule, not the exception, in complex situations.”⁹⁴ As the Army knows all too well from its historical and contemporary experiences, tactical success does not guarantee victory in these dynamic and rapidly changing environments.

To achieve strategic success, those planning and executing operations in the current context must demonstrate cognitive agility. The thought patterns that enable cognitive agility allow an individual to explore the interconnectedness and emergence displayed by complex adaptive systems and anticipate the multiplicity of potential outcomes that can result from any action, small or large, on the system. Rigid, linear, and standard applications of thought will not achieve this level of understanding. Instead, flexible, creative, unprejudiced, and reflective thought patterns are required to gain understanding, reframe problems, generate options, and assess actions within dynamic and rapidly changing environments. However, an individual can not merely learn these thought patterns via institutional methods. Rather, these patterns emerge in the interrelationship between mind, body, and environment, and are therefore, inherently

⁹¹ Johnson, 20-21.

⁹² Dolman, 26.

⁹³ Emile Simpson, *War from the Ground Up* (New York: Columbia University Press, 2012), 1-2.

⁹⁴ Dorner, 65.

influenced by an organization's culture and climate.

Section Three: Making and Breaking the Brain Paths to Cognitive Agility

The previous section explored complexity and the types of thinking necessary to act and adapt in complex environments. This section analyzes the factors that influence an individual's thinking to demonstrate how the interrelationship between the mind, body, and environment can make or break the brain paths to cognitive agility. The research explores unconscious cognition such as heuristics and functional fixedness to demonstrate how little control Army leaders have over their own perception. It also explores environmental factors associated with work design, which can present a barrier to thinking in complexity and inhibit adaptive behavior. Cognitive theorist Andy Clark argues that "thinking occurs as the interrelationship between mind, body, and environment as "[h]uman sensing, learning, thought, and feeling are all structured and informed by our body-based interactions with the world around us."⁹⁵ The systematic perspective of thinking reveals a symbiotic relationship between mind, body, and environment; the mind initially perceives the environment which triggers bodily responses; those bodily responses have implications on cognitive processes like working memory, flexibility, and creativity; these implications then determine how an individual perceives and acts within the environment in the future. From this circuitous and interdependent relationship, thought patterns emerge which can either enable cognitive agility or result in rigid, product-driven behavior.

Heuristics: A Cognitive Construction of Reality

The way Army leaders perceive the features of a situation is particularly important to the processes of generating hypotheses and defining problems.⁹⁶ The key

⁹⁵ Andy Clark, *Supersizing the Mind* (Oxford: Oxford University Press, 2008), xxvi.

⁹⁶ Charles Sanders Pierce and Arthur Walter Burks, *Collected Papers of Charles Sanders Peirce* (Cambridge: The Belknap Press of Harvard University Press, 1966), 113.

role of unconscious cognition is to organize and interpret the information an individual takes in through his senses, which subsequently influences judgment and behavior. People often attribute conscious cognition to the key factors in defining problems and generating options such as deciding what information to pay attention to, interpreting and evaluating information, learning, and setting goals. However, cognitive theorist Timothy D. Wilson asserts people also commonly perform these important tasks unconsciously.⁹⁷ Every person's brain is different with experience and exposure shaping unique and intrinsic patterns of thought. Though the power of the mind is undoubtedly strong, these previously established thought patterns can easily degrade a leader's capacity for flexible, creative, unprejudiced, and reflective thinking by unconsciously filtering information deemed irrelevant by the unconscious mind.

The mind has a mind of its own, so to speak, and can decide what information is important, and what is not, without a leader even knowing this process is occurring. Unconscious cognition, or the mental work that produces impressions, intuitions, and many decisions, occurs in silence in the mind but is the impetus for judgment.⁹⁸ Cognitive theory distinguishes between two modes of thinking and deciding which relate to judgment; reasoning and intuition. Cognitive Theorist, Daniel Kahneman argues that reasoning is deliberate and requires effort, but "intuitive thoughts seem to come spontaneously to mind, without conscious search or computation, and without effort."⁹⁹ Although people do not express every passing thought or behave according to every impulse, the conscious monitoring that prevents erroneous judgment is normally lax, allowing people to express many intuitive judgments. Casual observation and

⁹⁷ Timothy D Wilson, *Strangers to Ourselves* (Cambridge, Mass.: Belknap Press of Harvard University Press, 2002), 271-72.

⁹⁸ Daniel Kahneman, *Thinking, Fast and Slow* (New York: Farrar, Straus and Giroux, 2011), 3.

⁹⁹ Daniel Kahneman, "Maps of Bounded Rationality: Psychology for Behavioral Economics," *American Economic Review* 93, no. 5 (2003): 1449.

systematic research both reinforce the idea that most thoughts and actions are normally intuitive, which suggests judgment is largely determined through unconscious processing, and can limit a leader's capacity for unprejudiced thought patterns.¹⁰⁰

Humans cognitively construct simplified mental models of the world of which heuristics are a byproduct. These models serve as mental short cuts leaders use to produce efficient decisions.¹⁰¹ However, Gerd Gigerenzer, a German psychologist, asserts that “[i]n making predictions and judgments under uncertainty, people do not appear to follow the calculus of chance or the statistical theory of prediction. Instead, they rely on a limited number of heuristics which sometimes yield reasonable judgments and sometimes lead to severe and systematic errors.”¹⁰² Judgment impacts a leader's ability to act and anticipate outcomes, and is dependent on the accuracy of that individual's heuristics.

A leader's experiences powerfully and unconsciously impact the conclusions reached when attempting to solve unfamiliar and complex problems through what is termed accessibility. This cognitive construct plays a critical role in the way the brain unconsciously decides what information is important and what information the brain can discard or stuff in to a dark corner in the mind. Accessibility refers to the ease of activation of potential information in memory, which an individual unconsciously uses to decipher sensory input. Information high in activation potential is “energized” and ready for use.¹⁰³ A leader is unlikely to use information low in activation potential to

¹⁰⁰ Daniel Kahneman and Shane Frederick, “Representativeness Revisited: Attribute Substitution in Intuitive Judgment,” in *Heuristics and Biases: The Psychology of Intuitive Thought* eds. Thomas Gilovich, Dale Griffin, and Daniel Kahneman (New York: Cambridge University Press, 2002), 49-81.

¹⁰¹ Gerd Gigerenzer, “How to Make Cognitive Illusions Disappear: Beyond ‘Heuristics and Biases,’” *European Review of Social Psychology* 2, no. 1 (1991), 16.

¹⁰² Daniel Kahneman, Paul Slovic and Amos Tversky, *Judgment under Uncertainty* (Cambridge: Cambridge University Press, 1982), 237.

¹⁰³ Wilson, 37.

select and interpret information in her environment, largely because of the cognitive effort required. Activation potential, or accessibility, is determined not only by what the mind unconsciously deems relevant, but also by how recently an individual has encountered the respective information, as well as the familiarity of a concept based on past exposure.¹⁰⁴ For example, one explanation of the military's slow response to popular uprisings in Vietnam and later in Iraq is that an unfamiliar situation led to a delay in the military's ability to accurately perceive the changing threat. Perhaps, it was not until the military reached a crisis point, that it began to understand the novel context of the war.

In conflict, the Army often faces emergent crises which defy "off-the-shelf" solutions. Nassim Taleb explains these crisis points as, "Black Swan" events. "Black Swan" events illustrate a severe limitation to people's learning from observations or experience and the fragility of their knowledge. He ascribes three attributes to this type of event. First, he calls it an outlier because it lies outside the realm of regular expectations, and nothing in the past convincingly points to the possibility of its occurrence. Second, when it occurs, it "carries an extreme impact." Third, after the fact, human nature drives those affected to concoct explanations for its occurrence to make it appear both explainable and predictable.¹⁰⁵ One develops expectations through exposure to patterns. Outliers are therefore possible when that pattern changes, causing a crisis. The reason humans can make "Black Swan" events explainable and predictable after a crisis is because the information to interpret the event then has high activation potential, whereas before, activation potential was limited.

In anticipation of crises such as these, the Army frequently uses history to design models for conducting future operations. Historical study trains the mind to

¹⁰⁴ Wilson, 244, 264-65, 271-72, 326, 348, 367-68, 439-440, 463-69.

¹⁰⁵ Nassim Nicholas Taleb, *The Black Swan* (New York: Random House, 2007), 299-300, 304-07.

develop recognizable patterns and enhances one's ability to sight anomalies. Historian John Lewis Gaddis, suggests that "[w]e know the future only by the past we project into it...If you think of the past as a landscape, then history is the way we represent it, and it's that act of representation that lifts us above the familiar to let us experience vicariously what we can't experience directly: a wider view."¹⁰⁶ However, one must consider Clausewitz's advice on the appropriate use of history. Clausewitz recommended an individual may use history in four ways: to explain an idea, to demonstrate the application of an idea, to prove the possibility of some phenomenon or effect, and to deduce a doctrine as evidenced by a combination of several events, or what Gaddis refers to as contingencies. Clausewitz warns, one must take care to handle history responsibly and avoid historical data leading to "wrong ideas and bogus theorizing."¹⁰⁷ Though history enriches one's understanding of human behavior and the complexity of war, it does not serve as a predictor; it can only serve as a guide for recognizing patterns in behavior to help anticipate the future.

Creating diverse interdisciplinary environments for collaboration is another way for the Army to overcome the limitations of individual heuristics. Though each individual within the collective environment is limited by his or her own heuristics, the aggregate of those individual thoughts and behaviors represents a heightened ability to perceive and interpret, and serves as its own complex adaptive system. The product of a diverse collective is collective knowledge. An individual gains knowledge through an understanding of how information fits together. Collective knowledge, on the other hand, refers to the ability of a collective to make accurate predictions. Using predictive models, there are two steps that lead to collective knowledge: first, diverse partitions lead to different forecasts or predictions; second, those diverse individual predictions

¹⁰⁶ John Lewis Gaddis, *The Landscape of History* (Oxford: Oxford University Press, 2002), 3, 5.

¹⁰⁷ Clausewitz, 171-173.

then result in collective accuracy. Although this specifically applies to predictive modeling, the findings suggest one can apply the same logic to anticipatory modeling. In predictive modeling, collective knowledge relates to likely outcomes. In anticipatory modeling however, collective knowledge relates to potential outcomes.¹⁰⁸ Multiple perspectives create redundancy in the system, whereby one person may identify a key aspect of the problem set or an element of the interconnectedness in the system, when another misses it.

Functional Fixedness: An Unconscious Hindrance to Creativity

Unconscious cognitive processes can inhibit a leader's ability to develop innovative and creative solutions to complex problems through a phenomenon called "functional fixedness." A report published in the *Journal of Psychology* described functional fixedness as occurring when the previous use of an object, or means, is a function dissimilar to the current demand of the problem set.¹⁰⁹ Out-of-the box thinking is an Army cliché, but the concept is a derivative of an experiment on functional fixedness, an insight-solving problem known as the "candle problem."¹¹⁰ In this experiment, researchers provide participants with a number of objects, such as a box, candles, tacks, and/or paperclips, and task them to mount three candles vertically on a screen at a height of about five feet.¹¹¹

The findings of the 1952 "candle problem" experiment suggest the manner in which the researchers presented the items, either inside the box or outside the box, led to substantial differences in the participants' ability to solve the problem, hence the term

¹⁰⁸ Scott E. Page, *Diversity and Complexity* (Princeton, N.J.: Princeton University Press, 2011), 224-228.

¹⁰⁹ Robert E. Adamson, "Functional Fixedness as Related To Problem Solving: A Repetition of Three Experiments." *Journal of Experimental Psychology* 44, no. 4 (1952): 288.

¹¹⁰ Koutstaal, 127.

¹¹¹ Adamson, 288.

out-of-the-box thinking. Koutstaal asserts that “[w]hen the tacks are presented contained within the box, most individuals find this to be a very difficult task. However, when the tacks are presented separately, then participants readily generate a solution.”¹¹² An individual becomes fixated on a way of looking at the object, based on its usual function, purpose or previous experience with the object. Koutstaal argues that the individual is then unable to consciously construct alternative uses for the object, even if doing so “is exactly what is needed in order to address a problem that we are intently trying to solve.”¹¹³

Army doctrine is alternatively prescriptive and proscriptive; both tend to promote functional fixedness as fixedness can occur from excessive specificity. Specificity inhibits imaginative thought by creating an unconscious reliance on the mind’s recently encountered examples. The theory of functional fixedness suggests examples and models can hinder creativity and divergent use of resources in problem solving. For example, functional fixedness could inhibit the Army’s ability to generate suitable options for using conventional forces to solve an unconventional problem. Previous use of an object - or force in this case - in a manner dissimilar to the manner required to solve the current problem can trigger functional fixedness, but it also occurs if the solution objects are presented in a manner so as to suggest a solution.¹¹⁴

The Army seeks mental models for adaptability, but heuristics perform an automatic function in perception in which mental models filter information, often without conscious consent of the individual. Though mental models can help an individual make sense of the unfamiliar, they can often result in prejudiced and inflexible thought patterns that lead to a failure to learn and adapt. Functional fixedness can inhibit creative thought, and may also prevent adaptive behavior, particularly if the

¹¹² Koutstaal, 127.

¹¹³ Ibid.

¹¹⁴ Ibid.

context of a given situation requires a novel use for an ordinary object. Establishing a full understanding of how thinking occurs in order to overcome deficient mental models requires further exploration of the complex adaptive system that exists in the interrelationship between the mind, body, and environment.

Work Design: A New Take on Working Smarter not Harder

Now listen to me, all of you. You are condemned men. We keep you alive to serve this ship. So row well, and live.

— Quintus Arrius, *Ben Hur*
(1959)

Just like overtraining can result in orthopedic injuries, overuse of the mind can result in a reduced cognitive capacity. Work design relates to the specifications of a job's contents, methods and relationships, designed to satisfy the organizational and technological requirements of the organization, and social and personal requirements of the organization and the job holder.¹¹⁵ Work design is the established environment in which an individual works, and significantly influences an individual's capacity for certain patterns of thought. A 2006 University of California study on work design found that management scholars and practitioners were still not satisfied with the creative output of professionals, even though the research on work design spans more than thirty years. The findings in the study contradict previously held work design assertions that "designing tasks to appear more meaningful and significant to the organization," will "extract even more mindful performance from designers, engineers, and other professionals."¹¹⁶ Instead, the study found:

Relentlessly mindful work, particularly work that exerts continuous demand on such core job dimensions as skill variety and autonomy if combined with high workload pressure, (multiple and unpredictable time demands and deadlines, multiple complex projects with differing time horizons), could undermine the ability of individuals to experience the positive psychological states that, in turn, foster and sustain creativity – such as high levels of experienced meaningfulness

¹¹⁵ Harold M. F Rush, *Job Design for Motivation* (New York: Conference Board, 1971), 5.

¹¹⁶ Kimberly D. Elsbach and Andrew B. Hargadon, "Enhancing Creativity through 'Mindless' Work: A Framework of Workday Design," *Organization Science* 17, no. 4 (2006): 470.

of work, knowledge of the actual results of work activities and experienced responsibility for work outcomes.¹¹⁷

Chronically high-workload pressures are the result of work environments in which competing priorities frequently interrupt task completion; assigned tasks are often both mindful and cognitively challenging; supervisors inflict short deadlines for task completion; and individuals lack control over the timing, pacing, and quality of work output. According to an article by Brigadier General Wayne Grigsby and associates on military staff structure in the Afghanistan counterinsurgency, “[f]or six to 12 to 15 months— for some, longer—staff officers work 16 to 18 hours a day[...]directing operations, sharing information, coordinating and planning.”¹¹⁸ Organization theorists Kimberly D. Elsbach and Andrew B. Hargadon argue that high workloads such as these inhibit creativity using the example of a corporate focus on improving shareholder value through downsizing forces. The corporate effort they reference encouraged professionals to simply do more work in less time, and with fewer resources - a concept familiar to the military. At the same time, the introduction of new information technologies (i.e., broadband networks, wireless computers, pagers, and mobile phones) in the work place provided supervisors with a venue to “demand work updates or request project changes at a moment’s notice, and expect that employees will provide instantaneous feedback on their progress.”¹¹⁹ Though managers originally designed these high workloads to be challenging and intrinsically motivating, instead they became relentlessly mindful and stress inducing. The study found that intense workload, time pressures, and frequent work interruptions results in professionals who are nearly half as creative as they would

¹¹⁷ Koutstaal, 586.

¹¹⁸ Wayne W. Grigsby, et al., “Cross-Functional Team Staff Structure in the Afghanistan Counterinsurgency.” *Army*, 2012, accessed February 28, 2015, <http://www.highbeam.com/doc/1P3-2697619561.html>

¹¹⁹ Elsbach, et al., 470.

be otherwise, given a better work climate.¹²⁰

In many ways, the Army's culture and climate has created a perfect storm – a product driven staff system which restricts flexibility and creativity coupled with doctrine that encourages heuristics. Psychiatrist Edward Hallowell studied frequently overworked employees and found that they can display signs of Attention Deficit Trait (ADT). ADT is a neurological trait, characterized by “distractibility, inner frenzy, and impatience” and completely caused by one's environment, unlike Attention Deficit Disorder (ADD), which is also neurological but has a genetic component.¹²¹ ADT occurs when input from an individual's workload surpasses his work capacity putting him in survival mode. In this state, the individual will often make impulsive judgments in an attempt to quickly bring to closure the matter at hand. The individual will feel “compelled to get the problem under control immediately, to extinguish the perceived danger lest it destroy him.”¹²² During this time, an individual who displays ADT lacks flexibility, sense of humor, and most importantly, the ability to deal with the unknown.¹²³ Dörner also discusses the impact of time pressure and asserts that it has a specifically psychological affect resulting in an “inability to think in terms of nonlinear causation rather than chains of causation.”¹²⁴ Framing and solving problems in a complex environment where there are many unknowns could end in disaster if coupled with a work environment that restricts flexibility and creativity, resulting in product-driven behavior. Without the time and capacity to think, a leader will “take the path of least resistance.” This path will lead an individual to revert to heuristics, whether

¹²⁰ Elsbach, et al., 471-72.

¹²¹ Edward Hallowell, “Overloaded Circuits. Why Smart People Underperform,” *Harvard Business review* 83, no. 1 (2005): 56.

¹²² Ibid., 58.

¹²³ Ibid., 58-59.

¹²⁴ Dörner, 33.

accurate or not, to manage complexity in an attempt to simplify the environment, and to fail to explore all possible solution sets, seeking a quick resolution instead.

However, while Hallowell suggests work design can inhibit thinking, conversely, “providing a work environment in which the brain can function at its best,” can enhance thinking.¹²⁵ On the other end of the spectrum from relentlessly mindful work is legitimate and scheduled mindless work. The Army is culturally opposed to this type of work, referring to behavior that appears unfocused or mindless, as shamming. However, intermittent periods of mindless work allow the brain to rest and generate negative feedback, bringing the brain back to a state of equilibrium. The University of California study on work design refers to mindless work as, “work that is low in both cognitive difficulty and performance pressures.”¹²⁶ The study suggests interjecting phases of mindless work with relentlessly mindful work to “allow professionals to experience breaks from their chaotic and mindful work to allow them to feel a sense of predictability and control, as well as to provide them with the cognitive capacity to work creatively on other problems.”¹²⁷

Brief recharge periods, either in the form of mindless work or breaks, allow for what Koutstaal calls the “incubation of ideas,” which in some cases can even resolve functional fixedness.¹²⁸ Cognitive theorist Kenneth J. Gilhooly and his associates suggest that “[w]hen faced with a task requiring that familiar objects be used in new ways, it seems that it would be helpful for respondents to put aside the task immediately and return to it after a period of time, allowing unconscious incubation processes to

¹²⁵ Hallowell, 59.

¹²⁶ Elsbach, et al., 470.

¹²⁷ Ibid., 480.

¹²⁸ Koutstaal, 587.

operate before undertaking conscious work.”¹²⁹ Cognitive theorists Ut Na Sio and Elisabeth Rudowicz assert that during the incubation period “activation spreads to the nodes representing the relevant concepts.”¹³⁰ They further argue that during this period “problem solvers become more sensitive to [the information], and the problem solving process is facilitated.”¹³¹

Breaks can also have negative consequences including enabling procrastination and requiring an individual to spend a significant amount of time relearning crucial details of their current project. However, the benefits of breaks in this case outweigh the risks. Scheduled and deliberate breaks can alleviate fatigue or distress, which helps mitigate symptoms of ADT or prevent it altogether.¹³² These recharge periods also allow time for reflection and, as Koutstaal argues, “may provide an opportunity for both passive and unconscious processing and active unconscious processing [...] and may foster positive affect and other social-affective responses that can increase flexibility of thinking and creativity.”¹³³

The findings of the research in this section suggest the interrelationship between mind, body and environment can either make or break the brain paths to cognitive agility. Heuristics determine how an individual perceives information and, if left unchecked, can allow an individual to make reasonable assertions or can lead to catastrophic and systematic errors in judgment. Functional fixedness limits an individual’s ability to develop creative solutions to both familiar and unfamiliar

¹²⁹ Kenneth J. Gilhooly et al., “Don’t Wait To Incubate: Immediate Versus Delayed Incubation In Divergent Thinking”, *Memory & Cognition* 40, no. 6 (2012): 975.

¹³⁰ Ut Na Sio and Elisabeth Rudowicz, “The Role of an Incubation Period in Creative Problem Solving,” *Creativity Research Journal* 19, no. 2-3 (2007): 307.

¹³¹ Ibid.

¹³² Quintus R. Jett and Jennifer M. George, “Work Interrupted: A Closer Look at the Role of Interruptions in Organizational Life,” *The Academy of Management Review* 28, no. 3 (2003): 498-500.

¹³³ Koutstaal, 588

problems. Work design also plays a critical role in thinking as high workloads can result in product-oriented behavior in the interest of preserving cognitive and physical energy in the search for a solution. These findings suggest the quest for adaptive behavior requires an understanding and consideration of the way in which thinking occurs. Cognitive agility is not just something one consciously acquires, but a capacity for thought that is deeply ingrained in organizational culture and climate, emerging as the interrelationship between mind, body, and environment.

Section Four: Analysis and Conclusion

The aim of this monograph is to determine how an individual must think to act and adapt in complex environments and how the mind, body, and environment interact to inhibit or enhance those patterns of thought. Evidence reveals two key findings: a link between thinking in complexity and cognitive agility; and the impact of the interrelationship between the mind, body, and environment on thinking. Those planning and executing operations in the contemporary environment must be able to think in complexity. Thinking in complexity requires flexible, creative, unprejudiced, and reflective patterns of thought, or the kind of thinking which comprise cognitive agility. Cognitive agility allows an individual to explore the interconnectedness and emergence of complex adaptive systems in order to anticipate the multiplicity of potential outcomes, and generate novel and effective solutions.

Multi-minded systems, like the US Army and its opponents, are complex adaptive systems, evidenced by the fact that they seek to learn. Complex adaptive systems display purposeful behavior which provides cohesion for the system as it seeks to maintain an equilibrium in pursuit of its ultimate purpose. Predictability is not possible in a complex adaptive system though one thing is for certain, change will occur and it will be expansive. These novel surroundings drive a need for adaptation which requires the application of preexisting information or a novel way to achieve the original purpose by generating either negative or positive feedback. Enabling adaptive behavior requires leaders who continuously learn through reflection, but it also often necessitates

creative leaders who develop innovative or counterintuitive methods for the organization to continue to thrive in novel contexts.

The ability for organizations to adapt and develop novel solutions requires a particular type of thinking at the individual level. Systems theory provides a model suggesting systems thinking involves viewing systems in terms of openness, purposefulness, multidimensionality, emergent property, and counterintuitiveness. These are the building blocks of the mental model one needs to construct in order to become a systems thinker and “escape the boredom or predictability,” of the familiar.¹³⁴ Though systems theory provided the initial framework for thinking in complexity, this monograph establishes a multi-disciplinary perspective on the kinds of thought patterns that enable cognitive agility in complex problem solving. Flexible, creative, unprejudiced, and reflecting thinking allows an individual to determine when an old approach is not working and a new approach is required. These thought patterns also enable experimentation without bias and the ability to achieve an iterative process of reshaping behavior to appropriately fit the actions of the force to a changing environment. These thought patterns together form a complex adaptive system, of which adaptability is an emergent property.

Several factors inhibit making the brain paths to cognitive agility. Unconscious cognition influences judgment, creativity, and flexibility. One of the key findings of the research is that often, cognitive theorists refer to the mind’s automatic cognitive processes as “mental short cuts,” or “the path of least resistance.” The reality is that many people are either lazy or simply do not have the time to put in the cognitive effort required to overcome flawed heuristics and instead, fall back on what they know to define what they do not know. These findings suggest if the Army wants to get better at solving complex problems, it needs to set conditions for better thinking in order to generate valid hypotheses and adequately define problems in unfamiliar and uncertain

¹³⁴ Gharajedaghi, 55.

environments. The Army can do this by allowing time for complex problem solving, providing the resources for historical study, and creating diverse interdisciplinary environments for collaboration.

The findings on functional fixedness suggest a need for the Army to consider how it uses cultural artifacts, such as models, concepts, and historical examples. Doctrine that is too specific or prescriptive risks inhibiting the natural creative process by leaving a permanent cognitive ink stain on an individual's perception and ability to solve problems flexibly and creatively. A culture that avoids "reinventing the wheel" in the interest of time and simplicity, or dogmatically adheres to doctrine because it intellectually disregards other models, can develop patterns where function follows form, and find itself in a positive feedback loop spiraling toward disaster.

The findings on work design reveal a correlation between workload and one's capacity for thinking, linking culture and climate to adaptability. Relentlessly mindful work inhibits creativity and flexibility while increasing the risk of attentional disorders. Environments with high workloads with no structured breaks produce product-driven behavior; a detriment to thinking in complexity. To overcome work design pressures and avoid cognitive quagmires, the findings suggest scheduled mindless work or breaks provide negative feedback to refresh the mind and allow ideas and information to incubate. Within the US Army planning culture, leaders are educated on the need for a plan-to-plan, but often, this plan lacks scheduled breaks for the incubation of ideas and reflection, leaving even time for a lunch or dinner break up to the individual who rarely actually finds the time to do so. The evidence on work design affirms the original suggestion that the Army can find the solution to unlocking organizational adaptability by considering how culture and climate affects individual thinking.

Rather than merely telling leaders to be adaptive, the US Army needs to think about how an organization fosters and sets conditions for better thinking to flourish. This monograph reveals that an organization should recognize and encourage people for their ideas rather than establishing validity of ideas based on rank or position of

responsibility. The monograph further reveals that complex problem solving is a task that presents many challenges to an individual's cognitive capacity and to be effective, it requires cognitive agility. To overcome these challenges, an individual who is required to think in complexity must have an appropriate amount of time to frame and understand the environment, develop options, reflect, and assess. These efforts also require building teams of multiple personalities, experience levels, and disciplines to provide a richer medium for exploring complexity. Throughout the problem-solving process, leaders of these multi-dimensional teams can generate negative feedback by scheduling breaks amidst mindful, deliberate work which allows people to recharge the minds and provides time for the incubation of ideas. Finally, organizations can increase the experience and knowledge of its members by developing and funding programs that increase opportunities for exposure to various cultures and disciplines, including cultural exchange programs, conferences and idea forums, and opportunities to lead in various subcultures of the organization.

This monograph does not aim to provide short-sighted remedies or aesthetically interesting models that promise to enhance cognitive agility. Instead, it aims to steer the discussion of adaptability away from band-aide solutions and toward a search for the fundamental problem affecting the Army's adaptability. Currently, the US Army is asking the wrong question when it comes to how to become more adaptive. The question is not how to institutionalize adaptive behavior. Rather, the question that requires further research is if the patterns in the Army's current culture and climate support the kind of thinking that enables adaptability, or if it has tendencies that stifle flexible, creative, unprejudiced, and reflective thinking. The answer to this question will allow the US Army to take steps toward actionable and lasting change without losing sight of its essential purpose.

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