Train with the Brain in Mind: Neuroscience Education as a Force Multiplier

by Michael J. Cheatham

> ***To think about the future usefully, we must describe change in a rigorous and credible way. Concurrently, we must creatively account for the unexpected by stepping outside the assumptions and certainties that anchor us today.***
>
> ***— Vice Admiral Kevin D. Scott***

Ever-increasing lethality and superior technology epitomize the American way of war. However, despite continued investments in technological innovations, military equipment alone has rarely sufficed to ensure victory.[1] Indeed, war is an affair with humans, not hardware. Until recently, widespread efforts to shape cognitive development in servicemembers remained a fringe issue. After more than a decade at war, acceptance of cognitive training is rising but is mostly limited to resilience-focused programs, such as Comprehensive Soldier/Airman Fitness and Defender's Edge.

Resilience is a complex, multi-dimensional construct through which individuals cope, withstand, recover, and grow in the face of stressors and changing demands.[2] Contemporary resilience programs integrate cross-functional education activities and programs such as mental and physical wellness; social activities; family, peer, and mentor support; and spiritual health.[3] As enterprise-directed endeavors, military resilience programs offer a broad array of training and tools to provide something for everyone. However, blanket approaches to cognitive training overlook important age-related differences and fail to directly enhance duty performance. Reliance on young adults—ages 17 to 25—to execute decentralized operations on the future battlefield should spur leaders to understand, tailor, and apply neuroscience research today.

The Joint Chiefs of Staff's *Joint Operating Environment 2035*, the U.S. Air Force's *Future Operating Concept*, and the U.S. Army's *Win in a Complex World* forecast future operating environments of unprecedented complexity, making agile and adaptive decision-making and

Major Michael J. Cheatham, U.S. Air Force, is the Commander, 374th Security Forces Squadron, Yokota Air Base, Japan. He holds a B.A. from the University of Arkansas and a Master of Military Art and Science degree from the U.S. Army Command and General Staff College, Fort Leavenworth, Kansas.

measured motor responses as critical frontline traits.[4] These environments require bold innovation in the human cognitive domain to ensure individual, leader, and team readiness. Service, branch, and unit leaders should begin incorporating tailored neuroscience research and education into unit training programs to enhance operational frameworks and improve young-adult reflexive performance in judgment-dependent situations.

...performance and operational risk stem from the brain's natural maturation and survival-based responses...

This article examines the relationships between young-adult brain development, operational responsibilities, and current and future operating environments. It briefly discusses foundational neuroscience education concepts with an emphasis on the neuroanatomy and physiological responses commonly exhibited by military-aged young adults. This article explores five core questions to help leaders understand how neuroscience education can aid in developing the performance of young adults in high-threat situations:

1. What living and moral forces shape how leaders train young adults?
2. What are relevant neuroanatomical fundamentals?
3. How does neuroanatomy influence physiological response?
4. What are the key neuroscience education takeaways?
5. How can leaders apply neuroscience education?

Living and Moral Forces Shaping Future Training

Leaders should study brain function to develop awareness—in themselves and their subordinates—regarding how neuroanatomical factors influence contextual interpretation and performance under threatening situations. As this article outlines, performance and operational risk stem from the brain's natural maturation and survival-based responses. Both young and mature adults are capable of good and bad decision-making. However, mature adults have a fully "wired" brain to help shape informed, interpretive decisions over uninformed instinctual reactions. Neuroanatomical limitations coupled with perceptual threat danger and time constraints characteristic of use-of-force situations leave young adults more vulnerable to committing errors than their mature adult counterparts.

The linkage between young adults and cognitive processing in perceived high-threat situations is an enduring military consideration. Nearly two centuries ago, Prussian military theorist Carl von Clausewitz remarked how the unpredictable nature of war creates cognitive dissonance or "fog" in the minds of young soldiers. Clausewitz discerned that when soldiers mentally processed environmental sensory inputs (i.e., peripheral sights, smells, and sounds), personal beliefs, and the threats themselves, fog pervaded.[5]

Neuroanatomical limitations stemming from developmental age and relative inexperience appear to amplify fog in chaotic or complex operating environments. Recent examples of situational miscalculations by civilian law enforcement officers and para-military agencies—actual or perceived—demonstrate how single instances of cognitive errors compromise the credibility and trust of the people they serve.

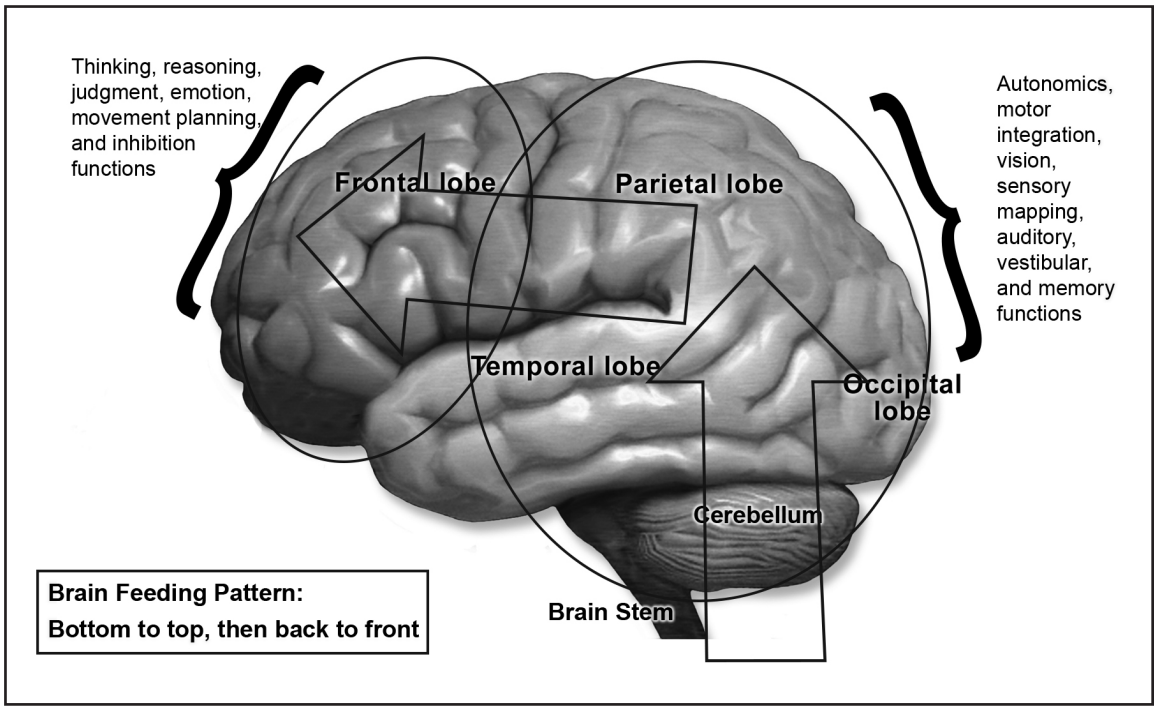

Figure 1. The Brain's Neural Flow.
Source: Created by author. Data adapted from Eric Cobb, Z-Health R-Phase Certification, 5th ed., Health Performance Solutions, Tempe, AZ, 2013, p. 5.

Despite consistently high perceptions of public trust, the U.S. military is not immune from the public's growing desire for decision-making perfection. With one eye on future operating requirements and the other on the implications of tactical errors, the U.S. military's internal and external pressures for its servicemembers to perform at near-zero-defect levels is palpable. Tactical-level judgment errors, captured and transmitted nearly instantaneously by non-traditional media, can strike at the U.S. "narrative space" and spark disastrous operational and strategic-level implications. Strategic leader interest in tactical-level performance will continue to grow if U.S. military forces become overextended, and dependence on decentralized operations and disciplined initiative increases.

Military branches employ young adults to conduct highly-contextual duties in gray circumstances—duties for which they may not necessarily be cognitively prepared. Thoughtful training and leadership create a context for change. Neuroscience is a critical part of this context development.

Relevant Neuroanatomical Fundamentals

Neuroscience education is the synthesis of relevant neuroanatomical and physiological response processes. In the context of this article, neuroscience education aims to improve self-understanding of brain functions and cognitive limitations based on age. Current neuroscience research indicates human brain maturation requires at least 26 years.[6] Even more surprising, emerging neuroscience research suggests brain integration could continue beyond age 30.[7]

Over the last decade, the National Institute of Mental Health conducted a major study to examine how brain regions activate over the first 21 years of life.[8] The study found that the brain's connectivity and input patterns move from the bottom of the brain to the top and from the back of the brain to the front (see Figure 1).

Consequently, the brain operates in the same fashion as it evolved. The brain's bottom-to-top and back-to-front neural flow is significant to understanding how neural integration occurs and sensory information is processed.

The brain operates as a "system of systems" model. As the young-adult brain matures, systems increasingly integrate from evolutionarily primitive autonomic brain systems to high-functioning cognitive systems. In general, young-adult brains are only about 80 percent mature, with the strongest connections rising from the lower-back (i.e., the brain stem).[9] The remaining 20 percent, located in the upper front (i.e., the frontal lobes) where the neural integration is weakest, is crucial to controlling self-behavior. Indeed, the very last places to "link" and the areas of weakest integration until approximately age 26 or beyond are the frontal lobes.[10] Weak frontal-lobe integration helps explain why young adults sometimes behave in risky or irrational ways.[11]

Weak front-brain integration, such as that commonly found in young adults, presents frontal lobes that are less capable of rationally evaluating threats.

The frontal lobes regulate executive functioning. As the brain's highest processing system, the frontal lobes act together to generate characteristic human behaviors and decision-making.[12] The frontal lobes coordinate or inhibit other parts of the brain, help the mind focus on key situational aspects, generate long-term planning, and enable critical and creative thinking processes.

Under threat, a well-integrated brain accesses frontal lobe resources to make sense of perceived threats from a rational perspective. Weak front-brain integration, such as that commonly found in young adults, presents frontal lobes that are less capable of rationally evaluating threats.[13]

The result is a brain that may be structurally ill-equipped to anticipate the potential consequences of actions. Incomplete brain development also impacts the production of critical thought and agile decisions under pressures characteristic of military and law enforcement situations.

Physiological Response Considerations

While the frontal lobes represent the hallmark of all neuroanatomical evolution, they are not a primal autonomous system. In the 26 years it takes for the frontal lobes to develop fully, the brain relies on the limbic system and the autonomic nervous system (ANS) to ensure survival during high-threat situations. [14] In general, as the brain matures and myelinates, the ability to regulate the limbic system and the ANS increases.[15] Regulating the limbic system and the ANS improves the probability of making appropriate decisions faster in high-threat situations,[16] which explains why young adults who lack experience and the full ability to inhibit limbic and ANS responses are more prone to display impulsive or unintentional reactions or hesitation when faced with high-threat decisions.[17]

The central nervous system (the brain and spinal cord) and the peripheral nervous system comprise the nervous system. The ANS is one of two primary peripheral nervous system components and consists of two major subsystems: the parasympathetic nervous system (PNS) and the sympathetic nervous system (SNS). As the term "autonomic" suggests, the ANS reflexively performs tasks that most neither think about, nor have much control over without awareness or deliberate training.[18] (See Figure 2.)

Together, the PNS and SNS operate in a mutually-supporting, alternating fashion to maintain a state of homeostasis. Under normal operating conditions, the PNS is dominant. The

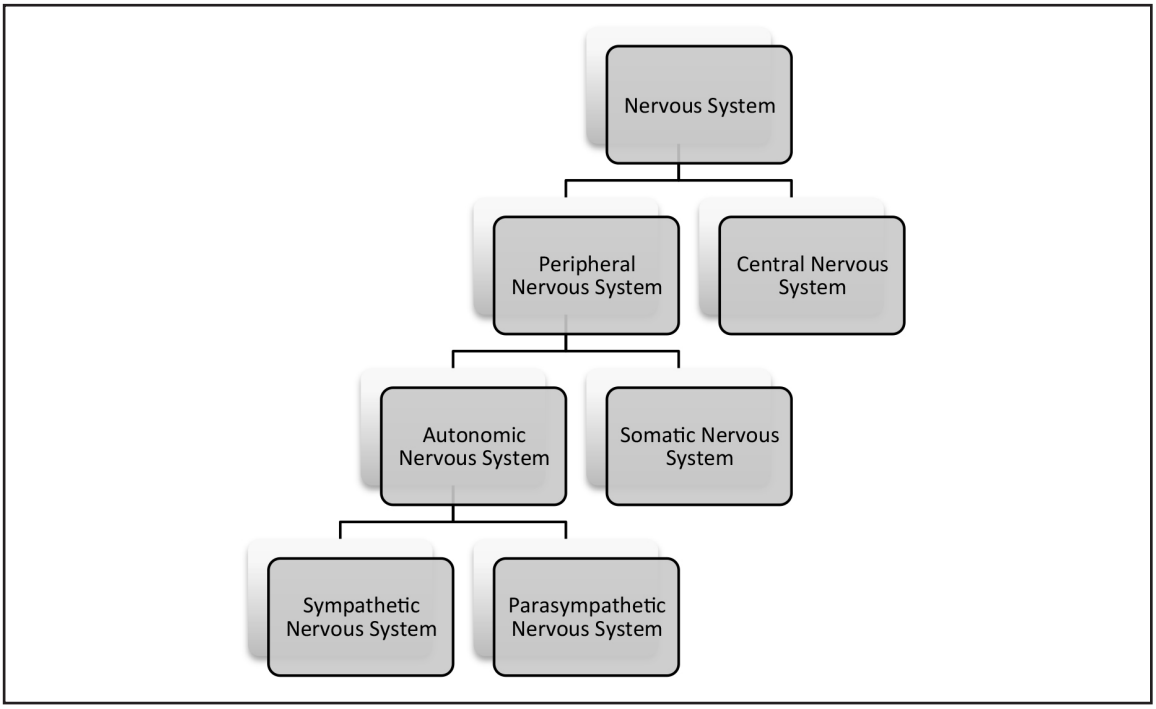

Figure 2. Nervous System Hierarchy.
Source: Created by author. Data adapted from Sandra Blakeslee and Matthew Blakeslee, The Body Has a Mind of Its Own, Random House, New York, 2007, p. 183.

PNS regulates heart rate, breathing, digestion, and many other functions that are essential for survival.[19] Exposures to threat activate the SNS and disrupt normal PNS function.

The SNS prepares the body for fight, flight, or freeze responses. The degree to which the SNS activates depends on the level of perceived threat. Under extreme threat, the SNS can cause catastrophic failures in the visual and memory centers, executive functioning, and motor control.[20] SNS effects last as long as the perceived threat exists, until catastrophic failure occurs, or the PNS is reactivated.[21]

The activation of the SNS is dependent on how the limbic system's thalamus interprets and processes the perceived threat. The thalamus acts as a sensory input gatekeeper, directing where information processing will occur to create an output. The thalamus directs sensory inputs to the low road or high road.[22] The differences between the two pathways are rate of speed and interpretation clarity. The low road is a raw, unfiltered direct input to the amygdala—the brain's fear response center. The high road also feeds into the amygdala but with clearer, more refined information input.

The low road is the brain's quickest way to create a motor output. The purpose of this primitive pathway is to generate a survival response before the brain fully understands what is happening.[23] A classic example of low road processing involves walking on a path and seeing a snake. The natural reaction is a startle reflex. Only after additional cognitive processing does one realize the "snake" was nothing more than a harmless stick.[24] The low road is an evolutionary protective mechanism that enables the brain to generate fight, flight, or freeze motor responses in less than 12 milliseconds.[25]

The low road operationalizes at a very young age. Based on an individual's internal model (previous sensory input, life experiences, cultural factors, and perception of social or work environments), the low road signals the

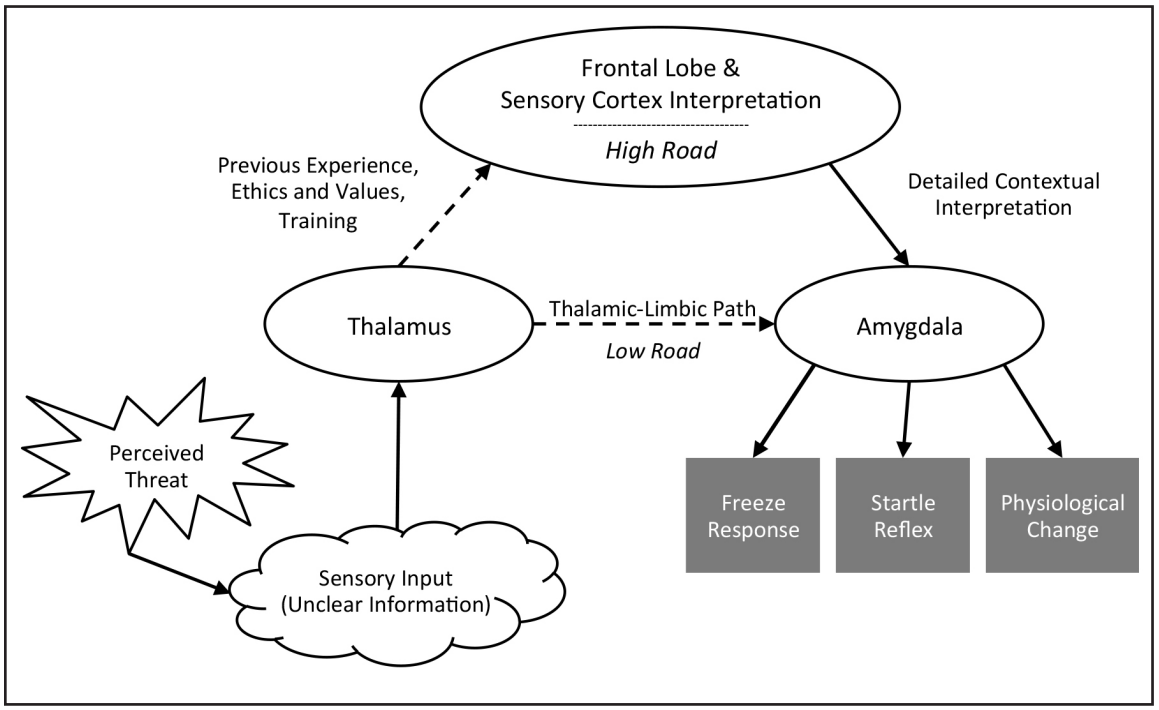

Figure 3. The High Road/Low Road Response.
Source: Created by author. Data adapted from Joseph LeDoux, The Emotional Brain: The Mysterious Underpinnings of Emotional Life, Touchstone, New York, 1996, p. 64; David Eagleman, The Brain: The Story of You, Pantheon Books, New York, 2007, Kindle, p. 772.

amygdala to "sound the alarm" and mobilize sufficient SNS functions.[26] Unfortunately, a low road response is not always appropriate. (See Figure 3.)

Conversely, the high road offers the brain an alternative to uninformed, survival-based actions. The high road applies cognitive processing "filters" to produce more accurate and detailed interpretations but at a slightly slower motor response—from 12 to 36 milliseconds.[27]

There is a clear connection between frontal lobe development and the low road/high road paradigm. Research suggests there is a gradual, but non-linear shift from low road to high road processing as the young-adult brain matures and gains experience.[28] Default frontal lobe processing (high road or low road) is a prime delineator between mature and young adults. It helps explain why young adults often struggle to regulate emotions, especially in crisis situations. The good news is the brain is not fixed. The brain is trainable. Neuroplasticity or brain adaptability is the rule not the exception.[29]

Neuroscience Education Takeaways

What is the relevancy for military leaders of neuroanatomical fundamentals and physiological response considerations? In high-threat situations, personnel will respond using one of two neural flow pathways to interpret a situation and generate a motor response. The low road produces a fast but hard-to-predict response. Under threat, the brain reverts to encoded data to process what is going on and to predict what will happen. The data retrieved, whether from an instinctual response, experiential memories stored in the amygdala, or ingrained training, determines the brain's response.

Relying on the brain to recall limited training or experiences is hit-or-miss, especially for young adults. Without sufficient encoded training or integration of the frontal lobes, prior

experiences stored in the amygdala dominate the brain, and reactions are protective but uninformed survival responses. Response is highly individualistic. Response unpredictability underlies the performance output and risk concerns during use-of-force employment. Thus, training should incorporate individual response.

The high road is the neural flow pathway the military profession demands—for young and mature adults alike. During high-threat situations, the high road is slightly slower than an instinctive reaction but highly effective in producing a rational response.

The ability to operate effectively in high-stress and quick-decision-making environments is challenging for young adults who lack full neuroanatomical capacity. Understanding how young-adult brain function develops and differs from mature-brain function presents significant challenges and implications for commanders and supervisors.

Leadership Applications

Commanders—regardless of branch or specialty—may not clearly understand the inherent risks of fielding a force primarily composed of young adults. However, recent lessons learned by civilian law enforcement should generate a sense of urgency for all services and branches to take an introspective look at how they train their servicemembers. Leaders should ask themselves: "Is our current training consistently producing the desired attributes required for tomorrow's operating environment?" Developing an awareness that gaps exist is the first step to enhancing young-adult duty performance.

Can leaders accelerate the shift from survival to performance processing in young adults? Leaders cannot "force" biological development to occur, but perhaps they can set conditions to enable change. Leaders have wide latitude in integrating neuroscience into performance training. There is no one way to produce positive performance results. Different organizations have distinctive needs based on their compositions and missions. However, creating awareness of young-adult-specific brain function and biological limitations and developing a deliberate practice culture are two recommended starting points for all organizations.

Commanders—regardless of branch or specialty—may not clearly understand the inherent risks of fielding a force primarily composed of young adults.

Neuroscience Education

Stages of change.

The first technique is to provide and integrate neuroscience education into formal training. Branch or unit leaders should develop and deliver a targeted "Neuro 101" course to inform young adults on their brain's structure and how its design affects judgment and decision-making. A "Neuro 101" course would move leaders and young adults from not knowing a problem exists (the pre-cognitive stage of change) to deciding if they want to act on that information (the awareness stage of change).[30] Neuroscience evidence should inform the "why" behind the "what" of military and law enforcement procedures and decision-making processes. Simply creating awareness that a cognitive gap exists will elicit behavior change. Additional research indicates that developing an awareness of brain functions and limitations creates a natural motivation to want to reduce those gaps.[31]

A key consideration behind the study's result is the average age of the study's participants. Most young adults are primed to receive similar education. Similar duty

performance results are possible. Creating awareness of brain structure and functions will nudge many young adults to take an active role in their professional and intellectual efforts. Even if results are modest, minor improvements applied across the future force are significant in both short- and long-term.

Deliberate practice.

The second technique requires a commitment to quality over quantity. Leaders focus on how available time is used, not on how much training time is available. Leaders should develop a culture of deliberate practice, building both motor and decision-making skills. Deliberate practice is defined as working on technical skill, seeking constant critical feedback, and focusing ruthlessly on weaknesses.[32]

Based on research of world-class performers from every domain, the deliberate practice model follows three primary guidelines:

- Practice with an explicit goal of getting better. The human brain is a target-focused system. Start each training block by identifying the specific skill being trained. A trainer's job is to create trainees who are fluent in the components of mission-essential tasks. Trainers must spend an inordinate amount of time teaching in the cognitive (crawl) and associative (walk) stages of learning as compared to the autonomous (run) stage. Trainers with limited time must focus on the "crawl" and "walk" phases and fight the gravitational pull to focus on the "run" phase. Many trainers mistakenly believe that all good training comes from the "run" phase when trying to master a skill. In reality, the greatest gains occur in the "crawl" phase. Even after mastering their specific skill, the best performers always return to the "crawl" stage to refine the basics that actually make them better.
- Stay in the moment and be present. Leaders should think about how training cycles are designed to maximize mental repetitions. Since it is rare for all trainees to participate at the same time, leaders should assess if the culture is conducive to learning by active viewership. Is the training area viewable by inactive trainees? Are phones allowed in the training area? Are noncommissioned officers talking through another team's performance with his team? Likewise, trainers involved must remain present for signs of threat response or startle reflex at the individual level and readily provide immediate feedback.
- Get as much feedback as possible. Immediate feedback is essential, especially in the "crawl" phase. Trainers should identify and address performance errors the moment they occur to avoid encoding poor motor movements. It is much easier to instill correct neuro- signatures or "muscle memory" than to alter an incorrect one. A properly trained, ingrained movement will retain its quality even as speed and intensity increases. Trainers must remain attuned to how trainees move in the "walk" and "run" phases. When motor outputs are no longer quality, stop training. The goal of training is to develop proper neuro-signatures to create skilled pathways for real-world application. Quantity over quality compromises neuro-signature development and produces diminishing returns.

The deliberate practice model offers leaders an adaptive training framework. Serious focus on the quality of training holds greater potential than quantity alone. Quality-focused training creates motor-response fluency by building and reinforcing brain myelination of gray matter. The quality of training expedites brain myelination and correlates to the quality of real-world decision-making.

Myelination increases integration between rear-sensory and front-motor cortices and the frontal cognitive system's synaptic speed, precision, and efficiency.[33] The results are not subtle—myelinated neurons deliver signals up to 100 times faster than non-myelinated neurons.[34] Increased synaptic speed helps level the response time deviation between the low road and high road.

Conclusion

There are no simple solutions to address the relationships between young-adult brain development, operational responsibilities, and current and future operating environments. However, leaders must be willing to wrestle with the unfamiliar and seek better ways to meet tomorrow's challenges.

What does the future look like with increased neuroscience integration into military training and operations? Predictive results are promising. Reviews of cross-functional domains and accumulating scientific knowledge indicate neuroscience integration could benefit a wide range of learners over broad fields.[35] Neuroscience offers leaders a unique lens from which to redesign training and lead operations. Leaders who operate using concepts grounded in neuroscience will open new avenues to improve young-adult effectiveness and reduce operational risk to a greater extent than those who do not.

The future operating environment will be the most complex in history. State and non-state adversaries will continuously seek to disrupt communications to gain positions of relative advantage. Decentralized operations relying on the concept of disciplined initiative to cope with uncertainty will dominate operations. The skills required to operate in this environment are not intuitive. Leaders must repeatedly explain and train the desired skills. Leaders who engage in neuroscience education and link available research to duty performance open new, viable approaches to improve individual decision-making and reduce tactical risk.

As history repeatedly reveals, militaries and branches that fail to innovate are destined to fail in future conflicts. Leaders should begin to embrace neuroscience concepts today to prepare young adults for the cognitive challenges of tomorrow. Training must evolve beyond traditional methods if and when scientific research identifies better ways. Indeed, better ways exist now. Now is the time to embrace innovative human performance strategies. ***IAJ***

> ***We now face another of those crucial moments in time. The dynamic, complex future is already beginning to challenge us. It is time for this generation of [leaders] to develop a way to succeed.***
>
> ***— Deborah Lee James***

NOTES

1 Geoffrey Parker, *The Cambridge History of Warfare*, Cambridge University Press, New York, 2005, p. 2.

2 Steven Kornguth et al., *Neurocognitive and Physiological Factors During High-Tempo Operations*, Ashgate, Burlington, VT, 2010, p. 3.

3 United States Air Force (USAF), Air Force Instruction 90-506, *Comprehensive Airman Fitness*, Washington, DC, 2014, p. 13.

4 Reminiscent of Marine Corps General Charles Krulack's concept of the "strategic corporal," future operational frameworks will undoubtedly rely on young adults to independently assess, interpret, and decide tactical-level actions at increasing levels.

5 Carl von Clausewitz, *On War*, Princeton University Press, Princeton, NJ, 2008, p. 108.

6 Satoshi Tsujimoto, "The Prefrontal Lobe: Functional Neural Development During Early Childhood," *The Neuroscientist*, Vol. 14, No. 4, August 2008, pp. 345–357, <http://dx.doi.org/10.1177>, accessed on December 31, 2016; Donald T. Stuss and Robert T. Knight, eds., *Principles of Frontal Lobe Function*, Oxford University Press, New York, 2002, p. 491.

7 Lin Edwards, "Brain Is Not Fully Mature until 30s and 40s," December 22, 2010, <http://medicalxpress.com/news/2010-12-brain-fully-mature-30s-40s.html>, accessed on November 5, 2016; Paul Howard-Jones, *Introducing Neuroeducational Research: Neuroscience, Education, and the Brain*, Routledge, New York, 2002, p. 6.

8 Jay N. Giedd, "The Teen Brain: Primed to Learn, Primed to Take Risks," February 2009, <http://www.dana.org/Cerebrum/2009/The_Teen_Brain_Primed_to_Learn,_Primed_to_Take_Risks/>, accessed on December 31, 2016.

9 Daniel J. Siegel and Tina Payne Bryson, *The Whole-Brain Child*, Bantam Books Trade Paperbacks, New York, 2012, p. 41; Frances E. Jensen and Amy Ellis Nutt, *The Teenage Brain*, HarperCollins, New York, 2015, p. 37.

10 Robert M. Sapolsky, *Why Zebras Don't Get Ulcers: The Acclaimed Guide to Stress, Stress-Related Diseases, and Coping*, Henry Holt and Company, New York, 2004, p. 229; Jason Satterfield, *Mind-Body Medicine: The New Science of Optimum Health*, The Teaching Company, Chantilly, VA, p. 25.

11 Jensen and Nutt, p. 37.

12 Satterfield, p. 25.

13 Susan Greenfield, *Mind Change*, Random House, New York, 2015, p. 88.; Jensen and Nutt, p. 269.

14 Sharon A. Gutman, *Quick Reference Neuroscience for Rehabilitation Professionals: The Essential Neurologic Principles Underlying Rehabilitation Practice,* SLACK, Thorofare, NJ, 2001, p. 4.

15 Mona Dekoven-Fishbane, "Wired to Connect: Neuroscience, Relationships, and Therapy," *Family Process*, Vol. 46, No. 3, August 2007, pp. 395–417, <http://dx.doi.org/10.1111/j.1545-5300.2007.00219.x>, accessed on December 2, 2016.

16 Richard Restak, *Mozart's Brain and the Fighter Pilot: Unleashing Your Brain's Potential*, Three Rivers Press, New York, 2001, p. 49; David A. Grossman, *On Killing*, revised ed., Back Bay Books, New York, 2009, p. 8.

17 Richard Restak, *Think Smart: A Neuroscientist's Prescription for Improving Your Brain's Performance*, Riverhead Books, New York, 2009, p. 18.

18 Frank Amthor, *Neuroscience for Dummies*, John Wiley and Sons, Canada, Ltd., Mississauga, Ontario, 2012, Kindle, p. 1265.

19 John J. Ratey, *A User's Guide to the Brain: Perception, Attention, and the Four Theaters of the Brain*, Pantheon Books, New York, 2001, p. 232.

20 Alexis Artwohl, "Perceptual and Memory Distortion During Officer-Involved Shootings," *FBI Law*

Enforcement Bulletin, Vol. 71, No. 10, October 2002, p. 18; David A. Grossman and Loren W. Christensen, *On Combat: The Psychology and Physiology of Deadly Conflict in War and in Peace*, 3rd ed., Warrior Science Publications, United States, 2008, p. 31.

21 Alan Ryan and Michael Evans, eds., *The Human Face of Warfare: Killing, Fear and Chaos in Battle*, Allen and Unwin, Australia, 2000, p. 15.

22 Joseph LeDoux, *The Emotional Brain: The Mysterious Underpinnings of Emotional Life*, 1st ed., Touchstone, New York, 1996, p. 164.

23 Ibid; Siegel and Bryson, p. 39.

24 Ledoux, p. 168.

25 W. Eric Cobb, *9S: Speed Certification Manual*, Z-Health Performance Solutions, Tempe, AZ, 2012, p. 46.

26 Ibid; Adriaan Louw and Emilio Puentedura, *Therapeutic Neuroscience Education: Teaching Patients About Pain*, International Spine and Pain Institute, Minneapolis, MN, 2013, p. 75.

27 Cobb, p. 46.

28 Ratey, p. 234.

29 Norman Doidge, *The Brain That Changes Itself*, Penguin Group, New York, 2007, p. 97; Uta Firth, ed., *Brain Waves Module 2: Neuroscience: Implications for Education and Lifelong Learning*, The Royal Society, London, 2011, <https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/2011/4294975733.pdf>, accessed on December 18, 2016.

30 Satterfield, p. 109.

31 A recent study informed teenagers on their neuroanatomy, physiological responses, brain plasticity and integration, and a clear message that they had control over their own brain development. The results were significant. Providing teenagers with neuroscience education created awareness and initiated changes from fixed mindsets to malleable growth mindsets. Once the subjects understood they were the responsible agents for their thoughts and brain growth, learning pathways changed as well. The differences between the experimental and control groups were substantial. Over a two-year period, the experimental group who received neuroscience education experienced a continuous upward trend of scholastic performance. Those who did not receive neuroscience education experienced a downward trend commensurate with the experimental group. The resulting disparity in performance between the two groups is significant to military leader efforts.

32 Daniel Coyle, *The Talent Code*, Bantam Books, New York, 2009, p. 51.

33 Kornguth et al., p. 88; B.J. Casey et al., "The Adolescent Brain." *Developmental Review*, Vol. 28, No. 1, February 2008, pp. 62–77, <http://dx.doi.org/10.1016/j.dr.2007.08.003>, accessed on October 31, 2016.

34 Giedd.

35 Louw and Puentedura, pp. 31–52.