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Use of Force in the 21st Century: Does Neurological Enhancement Change the Use of Force Equation?

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USE OF FORCE IN THE 21ST CENTURY: DOES NEUROLOGICAL ENHANCEMENT CHANGE THE USE OF FORCE EQUATION?

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“Soldiers having no physical, physiological, or cognitive limitation will be key to survival and operational dominance in the future.”¹

“Somewhere in between robotics and biomedical research, we might arrive at the perfect future warfighter: one that is part machine and part human, striking a formidable balance between technology and our frailties.”²

INTRODUCTION

The quotations above represent a well-known goal in military technology and advances: the ability to enhance soldiers and commanders beyond current human limitations and fallibility.³ However, the goal of creating a soldier capable of performing superhuman feats and escaping danger is not new in defense planning or even popular culture. Indeed, Marvel’s Luke Cage took on gene-editing⁴ before allegations that China might be attempting its own soldier gene-editing.⁵ While popular culture mirrors the very real goals and research of military laboratories, the enhanced soldiers in the Marvel universe are not assessed for compliance

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¹ Michael Joseph Gross, *The Pentagon’s Push to Program Soldiers’ Brains*, THE ATLANTIC (Nov. 2018), <https://www.theatlantic.com/magazine/archive/2018/11/the-pentagon-wants-to-weaponize-the-brain-what-could-go-wrong/570841/> (quoting Michael Goldblatt, former director of the Defense Sciences Office (DSO) in the Defense Advanced Research Projects Agency (DARPA)).

² Patrick Lin, *More Than Human? The Ethics of Biologically Enhancing Soldiers*, THE ATLANTIC (Feb. 16, 2012), <https://www.theatlantic.com/technology/archive/2012/02/more-than-human-the-ethics-of-biologically-enhancing-soldiers/253217/>.

³ Annie Jacobsen, *Engineering Humans for War: Inside the Pentagon’s Efforts to Create a Super-Soldier—and Change the Future of the Battlefield*, THE ATLANTIC (Sep. 23, 2015), <https://www.theatlantic.com/international/archive/2015/09/military-technology-pentagon-robots/406786/> (“One program in the DSO, called Persistence in Combat, addressed three areas that slowed soldiers down on the battlefield: pain, wounds, and excessive bleeding.”).

⁴ Yasmin Tayag, *Luke Cage Just Brought CRISPR Tech into the Marvel Universe*, INVERSE (Oct. 3, 2016), <https://www.inverse.com/article/21711-luke-cage-crispr-cas9-gene-editing-marvel-noah-burstein>.

⁵ Donovan Alexander, *China is Creating Biologically Enhanced Super Soldiers, Says US Spy Chief*, INTERESTING ENG’G (Dec. 4, 2020), <https://interestingengineering.com/china-is-creating-biologically-enhanced-super-soldiers-says-us-spy-chief> (discussing China’s possible use of gene-editing to augment its soldiers).

with *jus ad bellum* principles—those governing the resort to the use of force.⁶

This paper samples several categories of human enhancement to see how they affect decisions on whether a use of force is justifiable. In this way, the paper seeks to determine where human enhancements change the use of force calculus by influencing the assessment or outcome. The paper proceeds by defining “human enhancement” and exploring technological and pharmaceutical examples in the military context, outlining the legal principles involved in *jus ad bellum* use of force decisions, analyzing the effect of human enhancements on these legal principles, and concluding with several recommendations based on the preceding analysis.

I. HUMAN ENHANCEMENT

Human enhancement encompasses the ways by which people augment their bodies and minds to improve functioning or gain some advantage.⁷ The method of enhancement can take many forms,⁸ including pharmacological, brain-computer interfaces (BCI), prosthetics, and implants.⁹ Importantly, “enhance” does not necessarily mean “increase.”¹⁰ For example, decreasing a fear response could be an advantage to a

⁶ See Rotem Giladi, *The Jus Ad Bellum/Jus in Bello Distinction and the Law of Occupation*, 41 ISR. L. REV. 246, 246–47 (defining *jus ad bellum* as the legality of the use of force and *jus in bello* as the manner of force used).

⁷ Caterina Cinel, Davide Valeriani & Riccardo Poli, *Neurotechnologies for Human Cognitive Augmentation: Current State of the Art and Future Prospects*, FRONTIERS HUM. NEUROSCIENCE, Jan. 2019, at 1, 1. See also Patrick Lin, *Ethical Blowback from Emerging Technologies*, 9 J. MIL. ETHICS 313, 317 (2010) (“We . . . proceed on the assumption that ‘human enhancement’ and ‘human optimization’ are intelligible concepts and delineate at least some technological or biomedical applications from their therapeutic counterparts, including the ones that the military categorizes as such.”).

⁸ *Id.* Some scholars distinguish between enhancement and augmentation, arguing, for instance, that the former only refers to recovery or replacement of lost function to its previous level. In contrast, an augmentation would be restoring a lost or diminished function. For example, replacing a limb with a prosthesis would be an enhancement whereas a superior hearing device that allows you to listen well beyond what you normally could hear would be an augmentation. *Id.* at 2. For the purposes of this paper, the term “enhancement” includes “augmentation.” Dinnis & Kleffner similarly categorize enhancements as “biochemical, cybernetic (or brain-machine interfaces) and prosthetic.” Heather A. Harrison Dinniss & Jann K. Kleffner, *Soldier 2.0: Military Human Enhancement and International Law*, 92 INT’L L. STUD. 432, 434 (2016).

⁹ Dinnis & Kleffner, *supra* note 8, at 434. See also Raja Parasuraman & Scott Galster, *Sensing, Assessing, and Augmenting Threat Detection: Behavioral, Neuroimaging, and Brain Stimulation Evidence for the Critical Role of Attention*, FRONTIERS HUM. NEUROSCIENCE, June 2013, at 1, 2 (explaining that because of increasing demands in military applications of technological improvements, “humans and machines will need to become far more closely coupled, through improved human-machine interfaces and by direct augmentation of human performance”).

¹⁰ See Parasuraman & Galster, *supra* note 9, at 1, 2 (explaining that performance augmentation is meant to optimize mission effectiveness).

combatant who parachutes out of a plane.¹¹ Thus, the essence of an enhancement is in the advantage or improvement it offers.¹²

Scientific advancements have consistently been used over time to provide advantages in military operations. From global positioning satellites to computing technology, artificial intelligence, and stealth aircrafts, science offers advantages that could change how the military examines, assesses, and responds to any given attack.¹³ Neurological or cognitive enhancements provide an interesting example. What we typically think of as inherent characteristics, common thought-processes, or natural limitations within the average population, can be tweaked in ways that could consequently affect what we think a person may have seen, heard, or understood about any given situation.¹⁴ It may also affect the moral judgments that person places on any given decision.¹⁵ Given the potential cognitive effects, three forms of neurological enhancement are particularly relevant to the use of force context: (a) increasing perception and processing, (b) increasing focus and alertness, and (c) suppressing or preventing emotion.

¹¹ Andrew M. Lane, Gordon Bucknall, Paul A. Davis & Christopher J. Beedie, *Emotions and Emotion Regulation Among Novice Military Parachutists*, 24 MIL. PSYCH. 327, 327–28 (2012).

¹² See *id.* (“Given a better understanding of the causes for sub-optimal performance, targeted augmentation techniques can be employed to improve individual or team performance.”). See also Charles J. Dunlap, Jr., *The DoD Law of War Manual and Its Critics: Some Observations*, 92 INT’L L. STUD. SER. US NAVAL WAR COL. 85, 90–91 (2016) (discussing the definition of “military advantage” in the context of human shields).

¹³ See Andrea Farres, *Automatizing Patterns of Conduct: Can Artificial Intelligence Help Commanders Better Comply with the Principle of Distinction?*, OPINIOJURIS (Aug. 8, 2020), <http://opiniojuris.org/2020/08/29/automatizing-patterns-of-conduct-can-artificial-intelligence-help-commanders-better-comply-with-the-principle-of-distinction/> (artificial intelligence); Wes O’Donnell, *Stealth Fighter Jets: Have They Lost Their Advantage?*, INMILITARY (Oct. 10, 2019), <https://inmilitary.com/stealth-fighter-jets-have-they-lost-their-advantage/> (stealth aircraft); Rajat Bajjal & Manoj K. Arora, *GPS: A Military Perspective*, GEOSPATIAL WORLD (Sept. 1, 2009), <https://www.geospatialworld.net/article/gps-a-military-perspective/> (GPS technology); Terri Moon Cronk, *Defense Department to Move to Cloud Computing*, DOD NEWS (Dec. 21, 2017), <https://www.defense.gov/Explore/News/Article/Article/1402556/defense-department-to-move-to-cloud-computing/> (computing advances).

¹⁴ Cinel, Valeriani & Poli, *supra* note 7, at 1, 2 (“[B]y cognitive enhancement we mean the improvement of the processes of acquiring/generating knowledge and understanding the world around us. Such processes encompass attention, the formation of knowledge, memory, judgement and evaluation, reasoning and computation, problem solving and decision making, as well as the comprehension and production of language.”).

¹⁵ See CARMEL O’SULLIVAN, *KILLING ON COMMAND: THE DEFENCE OF SUPERIOR ORDERS IN MODERN COMBAT* 146 (Reece Walters & Deborah Drake eds., 2016) (explaining that desensitization and “moral drift” “significantly shift the soldiers’ standards of reasonable and acceptable conduct”).

A. *Increasing Perception and Processing*

Awareness, or “knowledge about the state of the same environment bounded in time and space,”¹⁶ is crucial for complex decision-making in military operations.¹⁷ To understand the unique situation at any given moment, a commander must take in information through sensory inputs, process it, and act on it, repeating this process continuously to maintain her awareness as the situation develops and changes.¹⁸ Neurological enhancements can improve a soldier’s perception and increase the amount of available information by improving sensory inputs beyond natural capabilities.¹⁹ These enhancements range from night-vision technology that increases visual acuity in otherwise hard-to-see operations²⁰ to emerging technologies like those developed through the Defense Advanced Research Projects Agency (DARPA) projects. For example, DARPA’s Neural Engineering System Design (NESD) project researches how neurotechnology can improve visual and auditory sensory input.²¹ DARPA also conducted research for a Cognitive Technology Threat Warning System (CTTWS), which worked on developing binoculars capable of “convert[ing] subconscious, neurological responses to danger into consciously available information.”²² Notably, an increase in information through enhanced sensory input does not mean an increase in *useful* information.²³ Indeed, enhancing a person’s sensory awareness and perceptual capabilities could in fact overwhelm the individual by requiring them to sort through vast amounts of information—a problem of human processing limitations, or cognitive load.²⁴

¹⁶ Sándor Munk, *Situational Awareness (Data) Bases in Military Command and Control*, 3 INFO. TECH. 373, 374 (2004) (“[S]ituational awareness is considered . . . knowledge created through interaction between an agent and its environment. In this sense, awareness can be simply defined as ‘knowing what is going on.’”).

¹⁷ Laura R. Marusich et al., *Effects of Information Availability on Command-And-Control Decision Making: Performance, Trust, And Situation Awareness*, 58 HUM. FACTORS 301, 301 (2016) (explaining that in command-and-control domains, including military operations, “information from various sources and of varying quality must be quickly assimilated and shared among distributed team members to make critical decisions”).

¹⁸ *See id.* (“[M]aintenance of awareness is accomplished through interaction with the environment (gathering information through sensory perception, and actively exploring surroundings based on the information picked up) . . .”).

¹⁹ Cinel, Valeriani & Poli, *supra* note 7, at 2.

²⁰ *See generally* Avi Parush, Michelle S. Gauthier, Lise Arseneau & Denis Tang, *The Human Factors of Night Vision Goggles: Perceptual, Cognitive, And Physical Factors*, 7 REVS. HUM. FACTORS ERGONOMICS 238 (2011) (describing night-vision technology, its capabilities and limits, and its application in military and civilian settings).

²¹ *Bridging the Bio-Electronic Divide*, DARPA (Jan. 19, 2016), <https://www.darpa.mil/news-events/2015-01-19>.

²² Michael N. Tennison & Jonathan D. Moreno, *Neuroscience, Ethics, and National Security: The State of the Art*, PLOS BIOLOGY, Mar. 2012, at 1, 1–2.

²³ *See* Marusich, *supra* note 17, at 302 (discussing cognitive load as the cognitive resources available to work on a given task like sorting useful from useless information and holding information in working memory).

²⁴ *Id.*

With this in mind, there is also research into improving processing abilities that help minimize cognitive load and thereby prevent information overload.²⁵ One example of technology to this end is brain-computer interfaces (BCIs), which are a broadly named category of technology that enable “bidirectional information flow (between the brain and a device).”²⁶ In other words, BCIs monitor brain activity and provide feedback on that activity in either a pre-programmed or manual and controllable manner.²⁷ BCIs have been developed to help integrate and filter the vast amount of incoming information to lighten the cognitive load.²⁸ DARPA’s CTTWS is one example because the technology helps the soldier visually identify threats by effectively pointing them in the right direction.²⁹ Research also goes into technologies capable of monitoring a soldier’s cognitive load in the field.³⁰

B. *Increasing Focus and Alertness*

The ability to focus and stay alert is critical to military operations, from threat detection to preventing pilot fatigue.³¹ For example,

²⁵ See ANIKA BINNENDIJK, TIMOTHY MARLER, ELIZABETH M. BARTELS, RAND CORP., *BRAIN-COMPUTER INTERFACES: U.S. MILITARY APPLICATIONS AND IMPLICATIONS, AN INITIAL ASSESSMENT 12* (2020) [hereinafter RAND REPORT] (“Extensive data and new sources of information may improve future situational awareness but could also complicate considerations for operational decisionmakers to process.”).

²⁶ *Id.* at 5.

²⁷ See Steffen Steinert & Orsolya Friedrich, *Wired Emotions: Ethical Issues of Affective Brain-Computer Interfaces*, 26 *SCI. & ENG’G ETHICS* 351, 352–53 (2020) (describing the state of BCI use in affective state research, including the ability to alter discreet emotions); Thomas ter Wijlen, *When Cyborg Meets Humanoid: A New Challenge for Human Rights* 42–43 (July 4, 2017) (Master thesis, University of Twente) (describing BCIs within the context of a cybernetic organism so that neural signals enable a person to control an artificial body).

²⁸ RAND REPORT, *supra* note 25, at 13 (“BCI systems could serve as a potential future tool support this endeavor, allowing human analysts and operator to monitor and exploit larger amounts of information more effectively.”).

²⁹ Tennison & Moreno, *supra* note 22, at 2.

³⁰ RAND REPORT, *supra* note 25, at 8. See also DOUGLAS S. SAVICK, LINDA R. ELLIOTT, OREST ZUBAL & CHRISTOPHER STACHOWIAK, ARMY RSCH. LAB’Y, *THE EFFECT OF AUDIO AND TACTILE CUES ON SOLDIER DECISION MAKING AND NAVIGATION IN COMPLEX SIMULATION SCENARIOS 1–17* (2008) (researching how sensory input cues, including visual, auditory, and tactile, affect the cognitive load and decision-making capabilities of soldiers through simulated exercises).

³¹ See Steven E. Davis & Glen A. Smith, *Transcranial Direct Current Stimulation Use in Warfighting: Benefits, Risks, and Future Prospects*, *FRONTIERS HUM. NEUROSCIENCE*, Apr. 2019, at 1, 12 (“There is potential scope for [technological enhancement] use in a number of key areas that directly affect practical battlefield advantage and survivability, such as deceptive capabilities, risk-taking, threat detection, perception, and physiological improvement.”). See generally ROYAL SOCIETY, *BRAIN WAVES MODULE 3: NEUROSCIENCE, CONFLICT, AND SECURITY 5–7* (2012) (describing various calls for proposals and ongoing projects, like those of DARPA and the U.S. Air Force Research Laboratory’s 711th Human Performance Wing (711 HPW) Human Effectiveness Directorate, Biosciences and Performance Division).

pharmaceutical enhancements like the neurological stimulants Dexedrine³² and Modafinil³³ have been used to varying degrees of success to reduce fatigue, especially for long flights.³⁴ Modafinil has seen particular success and popularity in military operations because it not only keeps a person awake, but also keeps her alert.³⁵ Technological enhancements, including BCIs, could also stimulate attention and focus in real-time.³⁶ One DARPA project, for example, looked into the ability of an electroencephalogram (EEG) device system for harnessing unconscious responses to threats.³⁷ The ability to stay awake and focused, especially for longer periods of time, has both direct and indirect military advantages. The direct effects of enhanced focus and alertness include better information collection and retention.³⁸ In this way, these enhancements can improve threat detection and information relay.³⁹ The indirect effect of the ability to stay awake and focused for longer periods of time is that fewer personnel may be required for each operation.⁴⁰ This is simply because fewer people are needed to switch out shifts when each individual can perform at the same level for longer periods of time.⁴¹ The

³² See Tennison & Moreno, *supra* note 22, at 2 (describing Dexedrine as “the amphetamine-based ‘go pills’ often used to reduce the fatigue induced by long missions”).

³³ Lin, *supra* note 2.

³⁴ *Id.*

³⁵ Armin Krishnan, *Attack on the Brain: Neurowars and Neurowarfare*, 9 SPACE & DEF. 4, 7 (2016).

³⁶ See RAND REPORT, *supra* note 25, at 16 (“Cognitively, [a BCI toolkit for the military] could yield enhanced focus and alertness for rapid and improved situational awareness and decision-making.”).

³⁷ See Krishnan, *supra* note 35, at 10 (2016) (discussing DARPA’s Cognitive Technology Threat Warning System (CT2WS) research).

³⁸ See generally Matthew P. Walker & Robert Stickgold, *Sleep-Dependent Learning and Memory Consolidation*, 44 NEURON 121–133 (2004) (describing the research related to sleep and memory, including effects of sleep on visual, auditory, and motor processes and memory).

³⁹ See Kevin Loria, *Brain Hacking is Having Incredible Effects and It's Just Getting Started*, BUSINESS INSIDER (Aug. 5, 2014), <http://static.businessinsider.com/brain-hacking-will-make-us-smarter-and-more-productive-2014-7> (“The increased focus [a BCI] provides can even give people a huge boost in U.S. military sniper training simulations. The military has also found that it can help pilots better pick out targets from radar images.”); Parasuraman & Galster, *supra* note 9, at 1–2 (describing “how non-invasive brain stimulation can be used to enhance threat detection and mitigate operator performance decrements” related to human attention limits).

⁴⁰ Ioana Maria Puscas, *Military Human Enhancement*, in NEW TECHNOLOGIES AND THE LAW IN WAR AND PEACE, 182, 183 (William H. Boothby ed., 2019).

⁴¹ *Id.* For example, if an operation requires a long flight, a certain number of air force pilots may be needed to attentively and alertly pilot the aircraft. If each pilot can stay alert and focused longer, then fewer pilots will be needed to complete the mission. In this way, an enhancement like Modafinil decreases the number of people involved in a given use of force operation. William Saletan, *The War on Sleep*, SLATE (May 29, 2013), http://www.slate.com/articles/health_and_science/superman/2013/05/sleep_deprivation_in_the_military_modafinil_and_the_arms_race_for_soldiers.html.

advantage is that fewer people are needed for each operation and resources are freed up for other uses.⁴²

C. *Suppressing or Preventing Emotion*

Emotions play an important role in war.⁴³ Emotions affect everything from decision-making⁴⁴ to the ability to collect and process information.⁴⁵ Available research suggests humans have an innate reluctance to harm or kill other people, acting as a human limitation on large-scale violence.⁴⁶ Consequently, military training and operations have long used neuroscience to limit or inhibit certain emotions.⁴⁷ For example, desensitization through repeated exposure to potentially shocking and frightening conditions can decrease emotional reactions to those stimuli over time,⁴⁸ potentially decreasing the chance of inaccuracy and increasing the potential follow through on the given order.⁴⁹ Given the extreme stress and unpredictability of modern war conditions, increasing efficiency of any given response will likely be advantageous.⁵⁰ In addition to stress, feelings of anger decrease perceived risk, while fear increases risk perception, providing the opportunity for advantages where these risk-related emotions can be regulated.⁵¹

While the relationship between neuroscience and the military is long-established, the methods and technology employed are constantly

⁴² Puscas, *supra* note 40, at 183–84.

⁴³ See Lane, Bucknall, Davis & Beedie, *supra* note 11, at 327–29 (explaining emotions in military contexts, focusing on emotions involved in parachuting).

⁴⁴ Andrea Bianchi & Anne Saab, *Fear and International Law-Making: An Exploratory Inquiry*, 32 LEIDEN J. INT’L L. 351, 361 (“The fact that emotions are closely intertwined with cognitive processes, make them relevant to assessing how reality is apprehended and processed, and how decision-making processes are triggered and implemented.”).

⁴⁵ See O’SULLIVAN, *supra* note 15, at 194 (“High levels of stress can hinder a person’s ability to gather information, to process the information gathered and to provide an accurate account of the events that took place.”).

⁴⁶ See *id.* at 105–11 (describing the research on human behavior related to aggression and killing as well as the conflicting burdens on soldiers of guilt and concern for fellow soldiers’ safety).

⁴⁷ See *id.* at 107–09 (describing desensitization techniques involved in basic training).

⁴⁸ *Id.*

⁴⁹ *Id.* at 194. Emotions can complicate a soldier’s ability to follow or execute orders. For example, a soldier thinking about the consequences of a kill order may hesitate or not act at all, potentially putting herself or her fellow soldiers at risk. See *id.* at 106–07 (suggesting that the low firing rate at exposed enemies in World War II and inaccurate firings in Vietnam may be linked to the innate desire to not harm other people).

⁵⁰ See *id.* at 121 (describing the emotional conditions of modern warfare).

⁵¹ See Ming-Hong Tsai & Maia J. Young, *Anger, Fear, and Escalation of Commitment*, 24 COGNITION & EMOTION 962, 963 (2010) (“[A]ngry individuals will perceive lower risk inherent in their initial decision, whereas fearful individuals will perceive higher risk inherent in their initial decision, which in turn will lead to different levels of escalation of commitment.”); Peter Margulis, *Autonomous Cyber Capabilities Below and Above the Use of Force Threshold: Balancing Proportionality and the Need for Speed*, 96 INT’L L. STUD. 394, 408 (2020) (explaining that emotions like fear and anger, can contribute to bias).

developing.⁵² These include both pharmacological and technological approaches to shaping emotional responses. For example, considerable research has been conducted on preventing the stress reactions and memory formation related to Post Traumatic Stress Disorder.⁵³ Immediate regulation can be found in non-invasive brain stimulation techniques, like transcranial direct current stimulation (tDCS), which enables electrical signals to alter brain activity that could affect emotional states.⁵⁴ BCIs can also moderate emotions, like reducing fear responses.⁵⁵ The advantage of such enhancements is that reducing stress could improve cognition related to situational awareness and decision-making and reducing fear could reduce perceived risk.⁵⁶ Emotion suppression can also make decisions more consistent or reduce mistakes, as human judgment and execution may be less reliable than, for example, autonomous systems in certain contexts.⁵⁷

Clearly, there is great potential in human enhancements for improving sensory perception and information processing, increasing alertness and focus, and emotional suppression. However, when these enhancements are applied in the military context, they should be assessed for how they affect decision-making, particularly those decisions involved in the use of force.

⁵² See, e.g., Robbin A. Miranda et al., *DARPA-Funded Efforts in the Development of Novel Brain-Computer Interface Technologies*, 244 J. NEUROSCIENCE METHODS 52 (2014) (describing the general development of BCI technology, focusing on more recent developments); RAND REPORT, *supra* note 25 (providing a broad overview of recent and potential future applications of BCI and other enhancement methods in the military).

⁵³ See Gross, *supra* note 1 (describing the neuroprosthetic approach that focuses on preventing memory formation related to PTSD through small brain implants); Tennison & Moreno, *supra* note 22, at 2 (describing the drug known as Propranolol, which has been studied for its ability to minimize trauma responses). In addition to research looking to prevent memory formation, DARPA has also researched the potential of “neurotechnologies to facilitate memory formation and recall in the injured brain.” Tristan McClure-Begley, *Restoring Active Memory (RAM)*, DARPA, <https://www.darpa.mil/program/restoring-active-memory> (last visited Aug. 3, 2021).

⁵⁴ See Davis & Smith, *supra* note 31, at 11 (explaining the authors’ opinion that tDCS should not be used in military contexts “likely to trigger strong emotional responses (such as those involving deadly force) . . . until more is known about the interactions between environmental stressors, individual differences, and the effects of stimulation”).

⁵⁵ RAND REPORT, *supra* note 25, at 15.

⁵⁶ O’SULLIVAN, *supra* note 15, at 194.

⁵⁷ See Michael N. Schmitt & Jeffrey S. Thurnher, “*Out of the loop*”: *Autonomous Weapon Systems and the Law of Armed Conflict*, 4 HARV. NAT’L SEC. J. 231, 248–49 (2013) (explaining that autonomous weapons systems may be preferential to humans where human judgment is less reliable and emotions can interfere); Lin, *supra* note 2 (“Fear and confusion in the ‘fog of war’ can lead to costly mistakes, such as friendly-fire casualties. Emotions and adrenaline can drive otherwise-decent individuals to perform vicious acts, from verbal abuse of local civilians to torture and illegal executions, making an international incident from a routine patrol.”).

II. USE OF FORCE: PROHIBITION AND KEY PRINCIPLES IN LEGAL DOCTRINE

International and customary law prohibits the use or threat of force.⁵⁸ Article 2(4) of the United Nations (U.N.) Charter specifically provides that “[m]embers shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations.”⁵⁹ The general prohibition of the use of force has its roots in Just War theory.⁶⁰ Under this theory, a war was justified when premised on a just cause preceding the war, such as a war undertaken in self-defense or to protect rights, and an exhaustion of other remedies.⁶¹ These principles appear in the modern exceptions to the general prohibition described below.

Article 51 of the U.N. Charter provides a self-defense exception to the prohibition on the use of force.⁶² To invoke self-defense, a state must be the victim of an armed attack.⁶³ It is also suggested that self-defense can be invoked when the decisionmaker reasonably and objectively believes an armed attack is imminent.⁶⁴ What is meant by “armed attack” is fact-dependent, and the International Court of Justice (ICJ) suggests it must be more than a “mere frontier incident,” determined by looking at the “scale and effects” of the attack.⁶⁵ For example, in *Nicaragua*, the ICJ held

⁵⁸ U.N. Charter, art. 2. para. 4. *See also* General Treaty for Renunciation of War as an Instrument of National Policy, Aug. 27, 1928, 46 Stat. 2343, 94 L.N.T.S. 57 (commonly known as the “Kellogg-Briand Pact”).

⁵⁹ U.N. Charter, art. 2. para. 4.

⁶⁰ *See, e.g.*, U.S. DEPARTMENT OF DEFENSE, LAW OF WAR MANUAL ¶ 1.1.1 (Dec. 2016) [hereinafter LAW OF WAR MANUAL] (“Certain *jus ad bellum* criteria have, at their philosophical roots, drawn from principles that have been developed as part of the Just War Tradition.”).

⁶¹ *See* John Forge, *Proportionality, Just War Theory and Innovation*, 15 SCI & ENG’G ETHICS 25, 26 (2009) (describing Just War theory, its principles, and relationship to modern-day *jus ad bellum* and *jus in bello* concepts).

⁶² U.N. Charter, art. 51 (“Nothing in the present Charter shall impair the inherent right of individual or collective self-defence if an armed attack occurs against a Member of the United Nations, until the Security Council has taken measures necessary to maintain international peace and security.”). The U.N. Charter also provides a second exception that allows the use of force when the UN Security Council authorizes enforcement under Chapter VII. INT’L & OPERATIONAL LAW DEP’T, THE JUDGE ADVOCATE GEN.’S LEGAL CTR. & SCH., U.S. ARMY, OPERATIONAL LAW HANDBOOK 1 (2018) [hereinafter OPERATIONAL LAW HANDBOOK].

⁶³ *Military and Paramilitary Activities in and Against Nicaragua (Nicar. v. U.S.)*, Judgment, 1986 I.C.J. 14, ¶ 195 (June 27) [hereinafter *Nicaragua*].

⁶⁴ *See* Brian Egan, *International Law, Legal Diplomacy, and the Counter-ISIL Campaign: Some Observations*, 92 INT’L L. STUD. 235, 239 (2016) (“The absence of specific evidence of where an attack will take place or of the precise nature of an attack does not preclude a conclusion that an armed attack is imminent for purposes of the exercise of the right of self-defense . . .”).

⁶⁵ *Nicaragua*, at ¶ 195. Notably, the United States does not agree in the distinction between a “mere frontier incident” and an “armed attack.” Thus, the United States reasons that it retains the right to act in self-defense in response to any use of force. Abraham D. Sofaer, *Terrorism, the Law, and the National*

that arms supplies and general support was considered a *de minimis* use of force short of that necessary to invoke self-defense.⁶⁶ Thus, a fact-specific assessment of the provoking incident, actual or imminent, should be made prior to invoking self-defense.

When self-defense is lawfully invoked, the use of force chosen to respond must comply in good faith with the principles of necessity and proportionality.⁶⁷ This involves a context-specific assessment,⁶⁸ including consideration of the changing “environment and tempo.”⁶⁹ Commanders and high-ranking officials, rather than soldiers, typically act as decisionmakers regarding the resort to force.⁷⁰ These decisionmakers must make their decisions about necessity and proportionality on a good faith basis.⁷¹ In other words, a commander’s decision to use force in self-defense should be assessed based on the information available to her at the time the decision is made.⁷² This does not mean that all reasonable decisions would be the same, because these decisions have subjective

Defense, 126 MIL. L. REV. 89, 93 (1989) (“The United States has long assumed that the inherent right of self defense potentially applies against any illegal use of force, and that it extends to any group or State that can properly be regarded as responsible for such activities.”). Further, some scholarship suggests an interpretation of the U.N. Charter by which an “aggression” can invoke the right of self-defense. See John Norton Moore, *Jus ad Bellum Before the International Court of Justice*, 52 VA. J. INT’L L. 903, 911–12 (2012) (generally describing interpretations where aggression allows for self-defense). See also *Prosecutor v. Tadić*; Case No. IT-94-1-AR-72, Decision on Defence Motion for Interlocutory Appeal on Jurisdiction, ¶ 562 (Int’l Crim. Trib. for the former Yugoslavia Oct. 2, 1995) (defining an armed conflict with respect to “two aspects of a conflict; the intensity of the conflict and the organization of the parties to the conflict”).⁶⁶ *Nicaragua*, at ¶¶ 237, 238. See David K. Linnan, *Self-Defense, Necessity and U.N. Collective Security: United States and Other Views*, 1 DUKE J. COMP. & INT’L L. 57, 70 (1991) (explaining how the self-defense exception under Article 51 of the U.N. Charter incorporates a *de minimis* approach through the “armed attack” language).

⁶⁷ *Nicaragua*, at ¶ 194. See also Noam Lubell & Amichai Cohen, *Strategic Proportionality: Limitations on the Use of Force in Modern Armed Conflicts*, 96 INT’L L. STUD. 159, 169, 186 (2020) (explaining that assessments of necessity and proportionality are sometimes conflated and that the legality of a use of force decision “suffers from inherent . . . ambiguity, and is uniquely complex.”).

⁶⁸ James A. Green, *Docking the Caroline: Understanding the Relevance of the Formula in Contemporary Customary International Law concerning Self-Defense*, 14 CARDOZO J. INT’L & COMP. L. 429, 450–51 (2006).

⁶⁹ Dinnis & Kleffner, *supra* note 8, at 443. See O’SULLIVAN, *supra* note 15, at 120–37 (describing the conditions of modern war, including the dynamic environment).

⁷⁰ See Lubell & Amicahi, *supra* note 67, at 190–92 (explaining the levels of decision-making for uses of force as well as the political and practical reasoning behind centralizing that power with the “highest levels of government”).

⁷¹ See LAW OF WAR MANUAL, *supra* note 60, at ¶¶ 2.2.3.3, 5.10.2.3 (explaining, for example, that “persons must assess the military necessity of an action based on the information available to them at that time; they cannot be judged based on information that subsequently comes to light”).

⁷² *Id.*

elements.⁷³ In practice, when deciding to use force, a commander would look to the information available to her at the time she makes the decision⁷⁴ and the time available for her to make the decision.⁷⁵

To be lawful, a use of force must be necessary.⁷⁶ The use of force is necessary⁷⁷ when all other possible remedies are exhausted.⁷⁸ While the precise scope of necessity is unclear,⁷⁹ the immediacy of the response may be one instructive measure in this assessment.⁸⁰ For example, in *Nicaragua*, the United States used force several months after the major incident at a time when the armed opposition was generally repelled and diminished.⁸¹ As a result, the ICJ held the use of force was not necessary because the threat had abated during the time lag.⁸²

⁷³ *Id.* (“The principle of proportionality typically involves the comparison of unlike quantities and values.”) (internal quotation marks omitted).

⁷⁴ *Id.*

⁷⁵ *Id.* at ¶ 5.10.2.4 (explaining that commanders can use force in doubtful cases with a good faith based on the information available to them).

⁷⁶ See Letter from Daniel Webster, U.S. Sec’y of State, to Henry S. Fox, British Minister in Washington (Apr. 24, 1841) (explaining that it must be the case that “the necessity of that self-defence is instant, overwhelming, and leaving no choice of means, and no moment for deliberation”).

⁷⁷ Lubell & Cohen, *supra* note 67, at 168.

⁷⁸ See OPERATIONAL LAW HANDBOOK, *supra* note 62, at 4 (“States must consider the exhaustion or ineffectiveness of peaceful means of resolution, the nature of coercion applied by the aggressor State, the objectives of each party, and the likelihood of effective community intervention. In other words, force should be viewed as a ‘last resort.’”).

⁷⁹ See Moore, *supra* note 65, at 911 (“The scope of the contemporary necessity criterion is notoriously indeterminate.”). One framework for necessity looks first at whether it was necessary to use force and second at whether the force used is necessary to respond to the force giving rise to it. Lubell & Cohen, *supra* note 67, at 168. However, such an approach overlaps to some extent with the proportionality approach. David Kretzmer, *The Inherent Right to Self-Defence and Proportionality in Jus Ad Bellum*, 24 EUR. J. INT’L L. 235, 239 (2013) (“[N]ecessity’ is also used to assess whether the force used was necessary to achieve legitimate ends of self-defence. When used in this sense there is an obvious affinity between necessity and proportionality. Means can only be proportionate when they are necessary to achieve the legitimate ends.”). As a use of force must be both necessary and proportional, assessing the overlap would be redundant. As a result, this paper discusses the need to balance the defensive force with the ultimate goal of using that force in the context of proportionality. See *infra* notes 84–88 and accompanying text.

⁸⁰ See OPERATIONAL LAW HANDBOOK, *supra* note 62, at 4 n.12 (quoting YORAM DINSTEIN, WAR, AGGRESSION AND SELF-DEFENCE 234–41 (5th ed. 2011)) (explaining that imminency plays in to whether the use of force is necessary “because a delay in response to an attack or the threat of attack attenuates the immediacy of the threat and the necessity to use force in self-defense”).

⁸¹ *Nicaragua*, at ¶ 237.

⁸² *Id.* Such an approach aligns with the principle of humanity, which forbids the infliction of suffering, injury, or destruction unnecessary to accomplish a legitimate military purpose. See Convention No. II with Respect to the Laws and Customs of War on Land, July 29, 1899, 32 Stat. 1803, T.S. No. 403 (“[W]hile seeking means to preserve peace and prevent armed conflicts among nations, it is likewise necessary to have regard to cases where an appeal to arms may be caused by events which their solicitude could not avert; Animated by the desire

In addition to necessary, a response must be proportional.⁸³ A proportional response is tailored to the act provoking it and to the legitimate goal of using force, such as repelling an attack.⁸⁴ First, to comply with this principle, the force used should be similar in magnitude or impact to the act that provoked it, but this does not require the force be similar in kind or type.⁸⁵ Second, to tailor the response to the legitimate goal, there must be a relationship between the force used and the goal of using the force, including a reasonable assessment of the overall harm that could result from resorting to force.⁸⁶ For example, the ICJ found the responsive force used in *Nicaragua*, including mining and attacks on ports, failed to be proportionate to the aid Nicaragua provided to the armed opposition.⁸⁷ Thus, the ability to understand the context of a given use of force and its potential consequences will play a role in determining whether a specific use of force was proportional to the legitimate end sought.⁸⁸

to serve, even in this extreme hypothesis, the interests of humanity and the ever increasing requirements of civilization”).

⁸³ *Nicaragua*, at ¶ 176.

⁸⁴ Lubell & Cohen, *supra* note 67, at 169. Lubell and Cohen discuss two approaches to proportionality. First, a “tit-for-tat” approach whereby the defensive use of force is measured directly against the provoking act. Second, a “means-end” approach that balances the defensive force against the legitimate aims of self-defense. *See also* Theodora Christodoulidou & Kalliopi Chainoglou, *The Principle of Proportionality from a Jus ad Bellum Perspective*, in OXFORD HANDBOOK OF THE USE OF FORCE IN INTERNATIONAL LAW 1187, 1191 (Marc Weller ed., 2015) (explaining that a double proportionality assessment combines the two major approaches). This paper takes the double proportionality approach.

⁸⁵ Robert Chesney, *Who May Be Killed? Anwar al-Awlaki as a Case Study in the International Legal Regulation of Lethal Force*, in YEARBOOK OF INT’L HUMANITARIAN L. 3, 70 (Michael N. Schmitt, Louise Arimatsu & T. McCormack eds., 2010) (“Proportionality in self-defense does not require a precise identity between the scale of the predicate attack and the scale of the force the defending state intends to use, but it does require some reasonable degree of relationship between them.”).

⁸⁶ LAW OF WAR MANUAL, *supra* note 60, at ¶¶ 1.11.1.2., 3.5.1 (explaining the difference between *jus in bello* and *jus ad bellum*, including the principle of proportionality as applied in each context). *See also* Prosecutor v. Galić, Case No. IT-98-29-T, Judgment ¶ 58 (Int’l Crim. Trib. for the former Yugoslavia Dec. 5, 2003) (“In determining whether an attack was proportionate it is necessary to examine whether a reasonably well-informed person in the circumstances of the actual perpetrator, making reasonable use of the information available to him or her, could have expected excessive civilian casualties to result from the attack.”). The DOD Law of War Manual assesses a commander’s judgment of the proportionality decision by a reasonableness standard. LAW OF WAR MANUAL, *supra* note 60, at ¶ 5.10.2.2 (explaining that a “Reasonable Military Commander” standard is one where decisions are reasonable).

⁸⁷ Christodoulidou & Chainoglou, *supra* note 84, at 1189–90.

⁸⁸ Enzo Cannizzaro, *Contextualizing Proportionality: Jus ad Bellum and Jus in Bello in the Lebanese War*, 88 INT’L REV. RED CROSS 779, 783 (2006) (“[A] proportionate response is one which is necessary and appropriate to repel the

In sum, a use of force in self-defense depends heavily on the context of the aggressor's armed attack in combination with the reasonable, good faith assessment of the necessity and proportionality of the responsive use of force. These fact-specific, reasonable assessments depend on the decisionmaker's perception, focus and alertness, and emotional response.⁸⁹ Whether altering these neurological pieces changes the use of force assessment is evaluated below.

III. USE OF FORCE ANALYSIS: HOW ENHANCEMENT CHANGES THE EQUATION

As discussed above, each part of the use of force assessment is highly context-dependent.⁹⁰ Changing a combatant's understanding of the context and nature of a provoking act or defensive use of force may affect the decision of whether the use of force is justified.⁹¹ Therefore, enhancements can change the use of force decisions and, potentially, the outcome. Consequently, a decisionmaker needs to address how use of force decisions are affected by (a) increasing perception and processing, (b) increasing focus and alertness, and (c) suppressing or preventing emotions.

A. *Increasing Perception and Processing: Beneficial to a Point*

Altering the perceptual and processing abilities of a soldier or commander will affect each step of the use of force analysis. The major benefit of improving the sensory capabilities is a potentially fuller factual understanding,⁹² which could affect whether self-defense can be invoked and good faith considerations of necessity and proportionality have been performed. However, potential information overload could create immediacy challenges for the principle of necessity.⁹³

i. Improved Factual Understanding and the Good Faith Basis

Enhancing sensory inputs and processing capabilities improves the factual understanding of the scenario, thereby affecting the commander's perspective of each step in the use of force analysis which requires a factual assessment.⁹⁴ This includes the assessment of (1) the actual or imminent armed attack to invoke self-defense, (2) the exhaustion of other remedies and immediacy of the response to ensure force is necessary, and (3) the reference again to the aggressor's attack to ensure the defensive use of force is proportional in scope and overall goal.⁹⁵ While improving the factual basis for a commander's decision, this

attack and which entails acceptable side-effects on other interests and values affected by the response.”).

⁸⁹ See Dinniss & Kleffner, *supra* note 8, at 478 (explaining how perception and enhancement factor into a person's understanding of material facts in the context of assessing intent and responsibility for crimes in war).

⁹⁰ See *supra* Section II.

⁹¹ See Dinniss & Kleffner, *supra* note 8, at 478 (explaining enhancements for perception and intent within the law).

⁹² *Id.*

⁹³ *Id.* at 444.

⁹⁴ *Id.* at 478.

⁹⁵ See *supra* Section II.

increased information load and processing speed simultaneously place a greater burden on the commander because she must consider in good faith the information available to her at the time she makes her decision.⁹⁶ Increasing the information available to her requires her to consider and filter through more information.

Consider night-vision technology used to monitor an aggressor's actual or imminent attack. Many military operations occur in the dark because it lowers the possibility of detection.⁹⁷ A commander who has the ability to spot an enemy preparing an attack—the number of troops involved, the weapons they are setting up, or the movement toward a particular border or target—has a better chance of differentiating between movement of the enemy and imminent attack.⁹⁸ Further, if an attack has already occurred in the dark, the night-vision assists a commander's ability to assess the damage to her own people and property. This allows her determine the scale and effects of the attack and thereby delineate between a mere frontier incident or armed attack.⁹⁹

Moreover, a commander would have a better understanding of the scope and magnitude of the attack, assisting her in deciding what kind of response scenarios would be proportional.¹⁰⁰ Prior to using force that is proportional in this narrow sense, she would also consider the ultimate goal of using force—such as fending off a future attack—and consider whether resorting to force would cause too much harm overall to in fact resort to force.¹⁰¹ Having the increased understanding of the enemy's whereabouts and readily available weaponry because the commander can view and monitor it with the enhancement technology would assist her in deciding the overall harm that may result from resorting to force and whether the use of force has a strong relationship to the goal of using force.¹⁰²

Finally, a better understanding of the facts assists the necessity assessment. A commander being able to see better during the night could, for example, see that the enemy forces were retreating or depleted, like those in *Nicaragua* at the time the United States used force.¹⁰³ Thus, the enhancement could affect the commander's assessment of whether force is necessary. Overall, enhancing sensory inputs play a large role in the factual analysis for use of force decisions.

An improved factual understanding of the armed attack or the peaceful alternatives available does not change whether a use of force decision is justifiable or reasonable, but it may better ensure each use of force is truly necessary and proportional. The commander's obligation in making a use of force decision is to do so based on the information available to her at the time—making her decisions on a good faith basis.¹⁰⁴

⁹⁶ Parasuraman & Galster, *supra* note 9, at 1–2.

⁹⁷ Parush, Gauthier, Arseneau & Tang, *supra* note 20, at 246.

⁹⁸ *Id.* at 246–47.

⁹⁹ *Nicaragua*, at ¶ 195.

¹⁰⁰ Chesney, *supra* note 85, at 70.

¹⁰¹ Parush, Gauthier, Arseneau & Tang, *supra* note 20, at 246.

¹⁰² Christodoulidou & Chainoglou, *supra* note 84, at 1189–90.

¹⁰³ *Nicaragua*, at ¶ 237.

¹⁰⁴ LAW OF WAR MANUAL, *supra* note 60, at ¶ 2.2.3.3.

This means that the proportionality and necessity decisions can be justifiable even with incomplete facts.¹⁰⁵ Consequently, a commander's disproportionate or unnecessary use of force will still be justified if the decision was reasonable based on the facts available to her at the time.¹⁰⁶ Even though justifiable under the circumstances, it is still a disproportionate or unnecessary use of force. If the enhancement would have allowed the commander to better understand the facts as they actually exist, it is possible her use of force would be more proportional to the armed attack or that she would have come across a remaining peaceful alternative. In this way, the enhancement, while not altering the reasonableness or justifiability of a specific use of force decision, will better ensure that each use of force is in fact proportional and necessary.

ii. Increased Cognitive Load and Necessity's Immediacy Element

While the potentially improved factual understanding would benefit the use of force assessment, a commander would need to get around the increased cognitive load that may accompany the increased sensory input to achieve the benefit.¹⁰⁷ Increasing the amount of information available to the commander means she has more information she must consider. This is because the proportionality and necessity assessments each must be made in good faith, meaning she considers the information available to her at the time she makes her decision.¹⁰⁸

If the use of force required only a retrospective analysis of a single moment in time, then the increased cognitive load may not be too problematic. However, the principle of necessity is dependent on the conditions as they exist in the moment: Is it necessary to use force *now* or have other peaceful resolution options become available?¹⁰⁹ Has too much time passed *at this point* since the aggressor's armed attack for the response to be truly necessary?¹¹⁰ The difference in time required for a good faith necessity decision between the enhanced and typical commander is likely not on the scale of months like the ICJ decided was too long for the force to be necessary in *Nicaragua*.¹¹¹ However, the dynamic nature of military settings suggests that in the time it takes to consider the available information from the enhancement, the conditions may have changed entirely.¹¹² As a result, the enhancement only becomes useful and strategically advantageous to the extent that a commander can realistically make sense of the incoming information in a timely manner. If the increased sensory input is coupled with increased processing speed

¹⁰⁵ Christodoulidou & Chainoglou, *supra* note 84, at 1196.

¹⁰⁶ LAW OF WAR MANUAL, *supra* note 60, at ¶ 2.2.3.3.

¹⁰⁷ Marusich, *supra* note 17, at 302.

¹⁰⁸ LAW OF WAR MANUAL, *supra* note 60, at ¶ 2.2.3.3.

¹⁰⁹ OPERATIONAL LAW HANDBOOK, *supra* note 62, at 4.

¹¹⁰ *Id.* at 4 n.12.

¹¹¹ *Nicaragua*, at ¶ 237. *See also*, McClure-Begley, *supra* note 53 (noting the potential of a DARPA memory-enhancing project called "RAM Replay" to "enhance military readiness by reducing the time required to respond to unanticipated threats").

¹¹² *See* O'SULLIVAN, *supra* note 15, at 120–37 (describing the dynamic environment of modern war).

such that the commander is not burdened by the additional information,¹¹³ then the necessity problem related to cognitive load would be resolved.

Enhanced sensory input and information processing have real potential to significantly improve use of force decisions by ensuring they relate to the reality of the facts underlying each step in the assessment. However, enhanced sensory inputs that increase cognitive load by overloading the decisionmaker with new information without a related increase in processing speed, may impede decision-making by interfering with good faith considerations and slowing down the process. As a result, enhancements in this category ideally couple the benefits of enhanced sensory inputs with improved processing and filtering capabilities—either built into a sensory-enhancing technology or through simultaneous but separate pharmaceutical or technological options.¹¹⁴

B. Increasing Focus and Alertness: Direct and Indirect Advantages

The enhancements that improve focus and alertness overlap with those improving sensory input and processing in terms of affecting a decisionmaker's factual understanding of each element of the use of force decision-making process.¹¹⁵ For example, defensive force must be proportional in magnitude and scope to the aggressor's armed attack, requiring an understanding of both the armed attack and the proposed use of force.¹¹⁶ Drowsiness and distraction can make it difficult to process and retain information as it is occurring.¹¹⁷ If the soldier was more alert in the moments leading up to the armed attack, such as one might be when using Modafinil, the soldier may be able to relay the facts better to the commander simply because she was better able to pay attention.¹¹⁸ In addition to this factual advantage, the focus and alertness enhancements provide some unique advantages and challenges to the use of force analysis because of their ability to affect threat detection and decrease personnel.¹¹⁹

i. Effects on Invoking Self-Defense

Enhancing focus and alertness may affect the ability to invoke self-defense. First, enhancing focus and alertness could make it more challenging to reach the *de minimis* threshold required to invoke self-defense.¹²⁰ Fewer soldiers in a location¹²¹ means that the scale and effects of any given attack on that location would be less than it would be without

¹¹³ Parasuraman & Galster, *supra* note 9, at 1–2.

¹¹⁴ RAND REPORT, *supra* note 25, at 8 (discussing the Cognitive Technology Threat Warning System (CTTWS) project, which has cognitive load-lightening technology built in to the enhancement).

¹¹⁵ See *supra* notes 97–103 and accompanying text for a discussion on how the improving understanding of the facts affects the use of force, primarily in relation to the good faith determinations of necessity and proportionality.

¹¹⁶ Chesney, *supra* note 85, at 70.

¹¹⁷ See RAND REPORT, *supra* note 25, at 16 (discussing BCI benefits for focus and alertness).

¹¹⁸ Saletan, *supra* note 41.

¹¹⁹ Parasuraman & Galster, *supra* note 9, at 1–2.

¹²⁰ Linnan, *supra* note 66, at 70.

¹²¹ Puscas, *supra* note 40, at 183–84.

the enhancement where more soldiers were required and consequently involved.¹²² Thus, the enhancement indirectly makes any given attack more like a “mere frontier incident” than an armed attack.¹²³

Second, enhancing focus and alertness may increase the chances of becoming aware of an imminent attack. To invoke self-defense in response to an imminent attack, a decisionmaker would need a reasonable and objective basis for believing an armed attack was imminent.¹²⁴ The ability to more closely monitor a range of situations for longer periods of time would increase the chances of identifying a potential threat and monitoring that threat to determine if it becomes an imminent armed attack.¹²⁵ Then, by making the factual picture more complete, the enhancement may assist the imminence assessment.

ii. Effects on Necessity and Proportionality

Enhancing the awareness or focusing abilities of the soldier or commander could affect the necessity determination to a small degree by altering response time. Having fewer soldiers in the field could mean there are fewer people to report on the factual situation on the ground. This could in turn cause delay in making a factual assessment of the necessity to respond with force in self-defense or require additional time to move additional people or resources to the area to mount a defense.¹²⁶ In this way, the indirect effect of using focus and alertness enhancing drugs or technology could impact the immediacy assessment for necessity. However, a time lag resulting from the decreased available personnel would probably not amount to the several months-long gap in *Nicaragua* that diminished the necessity of the response.¹²⁷ Thus, the enhancements related to focus and alertness would likely not impede the immediacy assessment to a point that would interfere with calling a response necessary. In fact, for enhanced persons not directly involved, but rather monitoring the situation from a distance, they may respond more quickly to a threat or attack because they became aware of it faster due to the enhancement.¹²⁸ Furthermore, the information relayed back to command from anyone on the ground would likely be superior to that of a soldier who did not have the attention and focus of one with the enhancement.¹²⁹ Thus, the ability to relay a fuller factual assessment of the need to use force would be assisted, despite a small potential time lag in assessment and response.

Enhancing the focus and alertness of a soldier may also affect the proportionality assessment by lowering the overall risk of harm related to

¹²² *Nicaragua*, at ¶ 195.

¹²³ *Id.* This is, of course, not to suggest that fewer injuries is bad or that a State should position itself so as to increase its chances of invoking self-defense. The prohibition on the use of force is still the law and ideal condition; self-defense remains the unfortunate exception. U.N. Charter, art. 2. para. 4.

¹²⁴ Egan, *supra* note 64, at 239.

¹²⁵ Davis & Smith, *supra* note 31, at 12.

¹²⁶ Puscas, *supra* note 40, at 183–84.

¹²⁷ *Nicaragua*, at ¶ 237.

¹²⁸ RAND REPORT, *supra* note 25, at 16.

¹²⁹ See *supra* notes 97–103 and accompanying text for a discussion on how improving factual understanding affects the use of force decision.

resorting to force. Proportionality requires analyzing whether the overall risk of harm from engaging in force is proportional to the goal of using force—re-establishing peacetime or fending off a continued or subsequent attack.¹³⁰ As discussed, increasing alertness and focus can decrease the personnel required for the defensive force.¹³¹ The force used remains the same. So too does the overall goal of using that force. The only change is less potential harm from using that force.¹³² Thus, Modafinil, and other focus and alertness enhancements, make the overall goal more proportional to the potential harm of resorting to force than the balance would be without these enhancements. Some argue that lowering the risk of harm to the party engaging in self-defense requires making war as terrible as possible to maintain the same level of disincentives for engaging in war.¹³³ However, this argument forgets that there are still limitations on the specific use of force in that it must have a proportional magnitude and impact.¹³⁴ Moreover, if the purpose of the prohibition on the use of force is in part to rid the world of the terrible outcomes of war, making the war itself worse seems to directly contradict the spirit of the prohibition.¹³⁵

The ability to remain focused and alert due to a human enhancement creates overall advantages in terms of improved understanding of the facts and decreased personnel. This latter advantage, decreasing personnel, should be monitored in a given use of force assessment related to whether the *de minimis* threshold for an armed attack has been satisfied and in terms of the overall proportionality assessment.¹³⁶ Overall, this enhancement category of increasing focus and alertness

¹³⁰ Heather M. Roff, *Lethal Autonomous Weapons and Jus Ad Bellum Proportionality*, 47 CASE W. RES. J. INT'L L. 37, 51 (2015) (“Proportionality requires that states are able to balance the relevant good against the evil they impose through warfare.”).

¹³¹ See Puscas, *supra* note 40, at 183–84, 217 (“It therefore seems possible that soldier enhancements may reduce overall soldier casualties but not death rates among peaceable civilians”).

¹³² A similar argument is seen where autonomous weapons systems require no human involvement at all. See Roff, *supra* note 130, at 42 (explaining the use of autonomous weapons systems for proportionality assessments and how “the harms imposed would be placed on the unjust aggressor and not on the combatants and/or civilians of the defending state”).

¹³³ See Lin, *supra* note 7, at 325 (explaining the argument that losing the disincentive for war related to potential harm requires offsetting it by making the war “as terrible as possible, to more certainly ensure that we engage in it as a last resort”).

¹³⁴ See Roff, *supra* note 130, at 47 (explaining that the argument that involving fewer soldiers is problematic for proportionality “artificially manipulates one’s sense of *ad bellum* proportionality by claiming that the harms suffered are either highly mitigated or absent because it assumes that the state using them will not face any additional threat from its adversary”). While beyond the scope of this paper, such an approach could also violate *jus in bello* principles that do not allow excessive harm or suffering. See, e.g., LAW OF WAR MANUAL, *supra* note 60, at ¶ 5.10 (“In accordance with the principle of proportionality, combatants must not exercise the right to engage in attacks against military objectives in an unreasonable or excessive way.”).

¹³⁵ Forge, *supra* note 61, at 26.

¹³⁶ Linnan, *supra* note 66, at 70.

appears to provide more benefits than concerns compared to the other enhancements discussed in this paper.

C. Suppressing or Preventing Emotion: Objectivity and Risk Assessment Effects

As an introductory point, it is helpful to remember that emotions, particularly stress, can impede accurate fact-reporting,¹³⁷ information collection and processing, and decision-making.¹³⁸ Like both enhancement categories previously discussed, enhancements that suppress emotions can improve the situational awareness and consequently the factual understanding of a given scenario.¹³⁹ In terms of the emotional component of factual assessment and communication, one example is how suppressing and preventing emotions may help commanders comply with invoking the right of self-defense to a certain extent. By suppressing soldiers' emotions that interfere with information collection and reporting processes, a soldier may be able to better communicate the situation as it stands.¹⁴⁰ As the scale and effects of the alleged attack is the difference between an armed attack allowing self-defense and a mere frontier incident that does not, a fuller factual basis would better serve this analysis.¹⁴¹ Unique to this category of enhancements, however, is the potential to improve rational and objective decision-making and affect the risk-taking judgment of the decisionmaker.

Preventing or suppressing negative emotions could improve the necessity and proportionality assessments by allowing for more methodical, objective assessments.¹⁴² For example, the stress of an armed attack may make it difficult to ensure that peaceful alternatives have been exhausted prior to resorting to force. Not only could shock, fear, stress, and sadness make it difficult to check off boxes,¹⁴³ but the anger and confusion in the wake of an armed attack could make it difficult to engage in peaceful negotiations.¹⁴⁴ Thus, enhancements suppressing these negative emotions could improve the good faith analysis of whether the use of force is truly necessary.¹⁴⁵

¹³⁷ O'SULLIVAN, *supra* note 15, at 194.

¹³⁸ *Id.* at 196 (explaining that stress, particularly in life-threatening situations, diminishes cognitive abilities, which "affects their ability to process information and make reasonable decisions").

¹³⁹ See *supra* notes 97–103 and accompanying text for the discussion on factual understanding.

¹⁴⁰ See O'SULLIVAN, *supra* note 15, at 194 ("High levels of stress can hinder a person's ability to gather information, to process the information gathered and to provide an accurate account of the events that took place.").

¹⁴¹ *Nicaragua*, at ¶ 195.

¹⁴² See Margulis, *supra* note 51, at 408 (explaining how emotions contribute to bias).

¹⁴³ See O'SULLIVAN, *supra* note 15, at 194 (explaining how stress can contribute to inaccuracy and inefficiency).

¹⁴⁴ See Roff, *supra* note 130, at 48 ("Substantial evidence indicates that when high levels of distrust, enmity, and hatred exist between warring parties, conflicts are prolonged and peaceful settlements are unlikely.").

¹⁴⁵ LAW OF WAR MANUAL, *supra* note 60, at ¶ 2.2.3.3.

Similarly, suppressing negative emotions could help prevent disproportionate uses of force by preventing overreaction and emotion-based decision making. Negative emotions like fear, anger, and sorrow could make it difficult to assess a situation separate from the emotional pain it causes the decisionmaker.¹⁴⁶ Further, feelings of anger like one may experience in response to an armed attack can be associated with lower perceived risk.¹⁴⁷ Thus, removing such negative emotions could help the proportionality assessment by assisting the decisionmaker to objectively assess the scope and magnitude of the armed attack and respond in a proportional manner.

However, emotions are a double-edged sword in use of force decisions. While negative emotions could cause overreactive and irrational decision-making, emotions may also provide a human limitation on unnecessary and disproportionate uses of force. The emotion of fear, for example, decreases risk-taking behavior by increasing perceived risk.¹⁴⁸ A commander may fear sending soldiers into harm's way, creating a more reasonably balanced judgment of the benefit of a given military operation. If that commander's fear is suppressed, she may move forward with the operation because she views it as less risky than she would without the enhancement.¹⁴⁹ Concerns about removing emotions from the use of force decisions in this way mimic the discussions on automated weapons systems, which make decisions without the emotional capacity of a human decisionmaker, including the ability to recognize the humanity of the enemy.¹⁵⁰ Making a person more like these systems, including for extended periods of time without the ability to alter that state, would therefore be potentially problematic.

Moreover, suppressing emotions could make it difficult to make ethical and good faith decisions.¹⁵¹ Recall that necessity and proportionality decisions are based on the *reasonable* consideration of information available at the time of the decision.¹⁵² For example, proportionality requires considering the potential goal of using force against the potential overall harm.¹⁵³ If a commander is unable to fear for the people who would be negatively affected from resorting to force, is she capable of considering the potential harm in a reasonable way?

¹⁴⁶ See, e.g., Roff, *supra* note 130, at 38 (explaining the benefits of removing emotions altogether from the *jus ad bellum* decisions include, for example, that “since machines are not affected by emotions, they will refrain from engaging in retributive acts against civilian populations”).

¹⁴⁷ Tsai & Young, *supra* note 51, at 963.

¹⁴⁸ *Id.*

¹⁴⁹ *Id.*

¹⁵⁰ See generally Amanda Sharkey, *Autonomous Weapons Systems, Killer Robots and Human Dignity*, 21 ETHICS & INFO. TECH. 75 (2019) (discussing a variety of concerns for autonomous systems due to a lack of emotions).

¹⁵¹ Matthew Beard, Jai Galliott & Sandra Lynch, *Soldier Enhancement: Ethical Risks and Opportunities*, 13 AUSTL. ARMY J. 5, 10 (2016) (explaining that the “ability to control emotional responses . . . make ethical judgments more difficult”).

¹⁵² LAW OF WAR MANUAL, *supra* note 60, at ¶ 2.2.3.3.

¹⁵³ See Roff, *supra* note 130, at 51 (“Proportionality requires that states are able to balance the relevant good against the evil they impose through warfare.”).

Research already shows that military training leads to a certain amount of moral drift—where “soldiers’ standards of reasonable and acceptable conduct” are shifted from what civilians consider reasonable.¹⁵⁴ If traditional training methods already contribute to skewed standards of reasonableness, completely removing emotions could exacerbate the problem. Some scholars argue that emotions are simply one reason a decision may be made and that the reason is not relevant to the reasonableness of the decision.¹⁵⁵ While true that emotions are not necessary to make a reasonable, justifiable use of force decision, removing a potential barrier for resorting to force seems counter to the goal of generally limiting its use.¹⁵⁶

Thus, enhancements that can suppress certain emotions have the potential to improve accuracy and objectivity in use of force decision-making.¹⁵⁷ Still, an enhancement that removes certain emotions altogether or that cannot be changed for extended periods of time is likely more concerning for the use of force assessment than is an enhancement that allows the operator to alter emotions as needed, such as the BCI technology for altering affective states.¹⁵⁸

IV. RECOMMENDATIONS AND CONCLUSION

The categories of human enhancement discussed here—improved sensory input and information processing, increased focus and alertness, and suppressed emotions—offer several overlapping advantages and concerns. One major theme of human enhancement in the military context is that it provides an improvement in the decisionmaker’s ability to learn about and understand the facts of an attack and the potential opportunities for response. For sensory input and processing, the improvement comes from the increased information available to the decisionmaker. For focus and alertness enhancements, there are better opportunities to detect threats and communicate the facts as they stand.¹⁵⁹ For suppressed emotions, there are possibly improved cognitive abilities related to information gathering and communication.¹⁶⁰ Regardless of how widespread this improvement is and how greatly it may affect the decisionmaker’s understanding of the facts, it will not change whether a use of force is justifiable. As noted, the justifiability of the decisions is judged on whether the decisionmaker reasonably considered the available information.¹⁶¹ As these human

¹⁵⁴ O’SULLIVAN, *supra* note 15, at 146.

¹⁵⁵ See, e.g., Michael N. Schmitt, *Drone Attacks Under the Jus ad Bellum and Jus in Bello: Clearing the “Fog of Law,”* 13 Y.B. INT’L HUM. L. 311, 320–21 (2011) (“Whether correct application derives from a sense of compassion, commitment to the rule of law, professionalism or a purported desire to win what is perceived as a video game is irrelevant.”).

¹⁵⁶ U.N. Charter, art. 2. para. 4.

¹⁵⁷ See O’SULLIVAN, *supra* note 15, at 194 (explaining how stress can increase inaccuracy and inefficiency).

¹⁵⁸ Steinert & Friedrich, *supra* note 27, at 352–53.

¹⁵⁹ Parasuraman & Galster, *supra* note 9, at 1–2.

¹⁶⁰ See O’SULLIVAN, *supra* note 15, at 194 (“High levels of stress can hinder a person’s ability to gather information, to process the information gathered and to provide an accurate account of the events that took place.”).

¹⁶¹ LAW OF WAR MANUAL, *supra* note 60, at ¶ 2.2.3.3.

enhancements become more ubiquitous, it is possible that judgments on what a *reasonable* consideration is will shift. For example, will it be considered unreasonable to rely on algorithms, intended to filter out information in service to the decisionmaker's cognitive load, without someone reviewing that filtered information? Will it be unreasonable not to suppress stress responses that could allow decisionmakers to better make sense of the information? As understandings of "reasonable consideration" and "available information" transform with views on what precautions or technologies should be used to better protect soldiers and civilians alike, it is possible the assessments of compliance with standards will change even though the standards themselves remain the same.¹⁶² This is also true for the other overlapping theme that these enhancements could affect the immediacy of the response related to the principle of necessity.

Overall, some general recommendations should be stated. First, States using human enhancements should consider how the specific enhancement—the pharmaceutical, implant, or non-invasive technology—affects the standards as interpreted by the State, the potential aggressor, and any reviewing body. Each of these actors may interpret a standard differently. For example, the U.S. interpretation on what is needed to invoke self-defense is any use of force, even though it may be considered a mere frontier incident by the ICJ or another State.¹⁶³ Thus, if the U.S. has enhanced sensory inputs that allows for a more sensitive understanding of the finer details and numbers, it may be more likely to invoke self-defense than a State who, even with the same enhanced sensory input, might believe the incident does not reach the *de minimis* threshold.¹⁶⁴

Second, States should begin keeping track of the standards as they develop over time and consider what, if anything, will be expected from them as they increasingly use the enhancements. For example, if a State decides to stop using Modafinil and ends up using more soldiers in an operation, might that be viewed as a disproportionate use of force or one that creates an increase in potential harm disproportionate to the overall goal?

Third, States should preference temporary, easily reversed enhancements over long-term or permanent ones. As discussed for emotion suppression, suppressing fear may be beneficial for a paratrooper, but because it also decreases perceived risk, it may interfere with the proportionality assessment of a decisionmaker.¹⁶⁵ Thus, enabling the individual to utilize the benefit of suppressing fear in the moment it is helpful while still enabling her to "turn it off" when it could interfere with her decision on the use of force would be the ideal scenario.¹⁶⁶

¹⁶² See Judith Gail Gardam, *Proportionality and Force in International Law*, 87 AM. J. INT'L L. 391, 400 (1993) (discussing the changes in proportionality doctrine over time, including how for aerial warfare "the main developments in the doctrine were a direct consequence of the advent of these new methods of warfare, whose use resulted in widespread damage to the civilian population").

¹⁶³ *Nicaragua*, at ¶ 195.

¹⁶⁴ Sofaer, *supra* note 65, at 93.

¹⁶⁵ Tsai & Young, *supra* note 51, at 963.

¹⁶⁶ This is only to say that the ability to use emotion-suppressing enhancements as needed is ideal compared to using similar enhancements without an ability to

Finally, States using human enhancements should assess the utility of each enhancement individually and contextually and be flexible about halting its use. Each emotion may have a different effect in a specific operation depending on the individual. Enhancing the vision of every soldier may have consequences unaccounted for at present. A soldier's ability to stay awake for days at a time by regularly using a pharmaceutical may not be worth any long-term health problems he may incur as a result. Thus, it is important for States to regularly assess these enhancements and consider the benefits and consequences not just for the use of force assessment, but also for the enhanced soldiers.¹⁶⁷

These enhancements represent impressive and potentially consequential scientific advances, moving toward the ideal super-soldier that has no weaknesses.¹⁶⁸ But eliminating the flaws and limits of the soldiers and commanders put into use of force situations should not be used to get around the limitations on uses of force. With this in mind, these enhancements should be studied further for how they can help to *avoid* resorting to and *halt* ongoing uses of force. Even though enhancing soldiers is advantageous, it is best to use these enhancements so that the use of force is avoided altogether.

control the timing of their effects. Other factors still need further consideration, like whether temporary, controllable emotion suppression presents too large of a moral hazard, ethical dilemma, or tactical risk to be worth the potential advantages. For example, moral hazards have been discussed with regard to military uses of drones. *See, e.g.,* Neil Jacobstein, *Drones: A 360 Degree View*, *WORLD POL'Y J.*, Fall 2013, at 14, 17–18 (noting that military drones present a moral hazard risk and discussing the issue of accountability for using the technology in military operations). The ethics of using any of the enhancements discussed in this paper should also be discussed further. *See generally* Sahar Latheef & Adam Henschke, *Can a Soldier Say No to an Enhancing Intervention?*, 5 *PHILOSOPHIES* 13 (2020) (discussing soldiers' potential autonomy to decline to use neuroenhancements); Rafael Yuste & Sara Goering, Comment, *Four Ethical Priorities for Neurotechnologies and AI*, 551 *NATURE* 159 (2017) (discussing ethical issues related to neurotechnology generally and recommending strict regulation of neurological augmentation in the military context specifically).

¹⁶⁷ *See* Lin, *supra* note 2 (discussing potential problems related to enhanced soldiers returning to civilian life).

¹⁶⁸ *Id.*