



A sailor downloads data from a REMUS autonomous underwater vehicle for analysis while deployed on Operation OPEN SPIRIT with Fleet Dive Unit (Atlantic) in Lithuania, on May 14, 2025.

Photo: Master Corporal Mark Wanzel

Autonomous Weapons and Cognitive Extension

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Countries are fast developing and fielding Lethal Autonomous Weapons System (LAWS). These weapons are debated in academic, legal, and policy realms where many raise ethical objections due to a perceived “accountability gap.” Such a gap could hinder prosecution of war criminals, threaten the moral conduct of war, and reduce respect for the Law of Armed Conflict.¹ Many focus on keeping LAWS under human control, but with no consensus on how this control is defined and how it can be exercised. The HEC, an increasingly popular view in contemporary cognitive science, provides a useful way to understand human control of LAWS. I first explore the ongoing LAWS debate and its failure to define human control. I then summarize the HEC and its application to human control of LAWS, looking at how humans interact with cognitive technologies generally, considering LAWS as cognitive artifacts, and comparing control of LAWS and human subordinates. I conclude that LAWS can extend cognition and be under human control even without immediate, conscious human intervention. Therefore, military processes such as training and issuing orders might allow commanders to exercise control of LAWS in ways that parallel control of human subordinates.

Vague Notions of Control

Academics have debated the ethical implications of LAWS for over a decade. Surveying this debate, most of them take positions that are skeptical of LAWS, if not outright opposed to their use. A common concern is the lack of human accountability for LAWS.² A minority of authors, such as Simpson and Muller, take a different view.³ They argue that responsibility rests with the commanders who armed and deployed the LAWS, and LAWS behaving unpredictably does not preclude their use. The debate is not merely academic but leads to calls for bans or limitations on LAWS based on a lack of human control.⁴

Various non-governmental organizations have taken strong positions on LAWS. The International Committee for Robot Arms Control advocates that we must act against the “pressing dangers that [LAWS] pose to peace and international security and to civilians in war.”⁵ The International Committee of the Red Cross (ICRC) made a submission to a meeting of the High Contracting Parties and Signatories to the Convention on Certain Conventional Weapons (CCW) focused on human control of LAWS stating that “it is essential that States develop common understandings on the elements and criteria of human control.”⁶ Even organizations peripherally interested in LAWS such as the Institute of Electrical and Electronics Engineers (IEEE) recommend that measures be taken to “help ensure there is meaningful human control of weapons systems.”⁷

States too have commented on the legal and ethical implications of LAWS, although stated positions may not be comprehensive nor aligned with actual state actions.⁸ Many of the articulated positions focus on human control of LAWS, but there is no consensus on what human control really means.⁹ The Chair of the Group of Governmental Experts proposed a working characterization of LAWS in 2025, but the ensuing debate shows that the issue of human control remains unresolved. Some parties still sought the qualification of “human control” with phrases such as “contextappropriate” or “meaningful,” but there was no agreement as “delegations reiterated their diverse positions shared during the [previous] exchanges.”¹⁰

Discussions of human control often reference a decision-action cycle or “loop.” Canada uses the “loop” terminology in official documents on LAWS, saying in the Canadian Army modernization strategy that “the requirement for a human in or on ‘the loop’ will remain for any application of lethal force.”¹¹ In 2013, Human Rights Watch articulated the following definitions:

- Human-in-the-Loop Weapons: Robots that can select targets and deliver force only with a human command;
- Human-on-the-Loop Weapons: Robots that can select targets and deliver force under the oversight of a human operator who can override the robots’ actions; and
- Human-out-of-the-Loop Weapons: Robots that are capable of selecting targets and delivering force without any human input or interaction.¹²

What constitutes “human command” or “oversight” in terms of time, space, and specificity? What about an autonomous weapon “commanded” to seek and destroy the largest target in a given area? Must human oversight be constant and real-time? Attempting to define human control by appealing to concepts such as “command” and “oversight” merely pushes the explanatory burden onto new terms. Some technical experts contend that the debate around LAWS remains “filled with a lack of technical literacy and emotional rhetoric.”¹³ Additionally, human oversight risks producing “automation bias” that Cummings argues can lead to new errors if human cognitive abilities are not considered.¹⁴

The ill-defined notion of human control frustrates progress in legal and ethical debates over LAWS. The ICRC notes that “there is general agreement among States that human control—be it qualified as ‘meaningful,’ ‘substantive,’ ‘appropriate,’ ‘sufficient’ or ‘effective,’ or ‘appropriate levels of human judgement,’ or ‘human involvement’—must be retained over weapon systems and the use of force.”¹⁵ This proliferation of adjectives reveals a lack of consensus and clarity. Bode and Heulss make the point that “[m]ultiple understandings of what meaningful human control implies present a complication.”¹⁶ Nations favourable to the development of LAWS thus question whether and how human control can be usefully defined, arguing that “it is doubtful whether criteria to determine a due level of ‘significance’ of human control over the machine could be developed.”¹⁷ Regulatory measures would seem impossible to implement based on a vague notion of control, let alone ones that can practically be applied in military operations.

To further complicate human control, LAWS can be autonomous in different ways and to different degrees.¹⁸ Retired U.S. Army officer Brian Cox proposes that we understand LAWS in terms of the degree of autonomy, what contribution that autonomy makes to their overall function, and their method of programming.¹⁹ Even in 2012, before many advancements in AI, the US DoD noted that “system autonomy is a continuum from complete human control of all decisions to situations where many functions are delegated to the computer.”²⁰ A 2017 report explores definitions of autonomy and describes weapon autonomy in terms of the capability accomplished autonomously.²¹ They find that a variety of systems (air defence, active protection, loitering munitions, etc.) can be autonomous in a variety of functions (mobility, targeting, health management, etc.).²²

It is useful, in light of the wide variety of LAWS, to focus my analysis on a particular type. Unpiloted aerial systems (UAS) or “drones” that are autonomous in the selection and prosecution of targets are the archetypal “killer robots” at the centre of LAWS debate. Discussion of such systems is not just hypothetical—a United Nations report indicates a possible first use of such LAWS in Libya in March 2020.²³ Ukraine has used UASs extensively in their ongoing war with Russia.²⁴ Some are carrying out attacks autonomously.²⁵ It is this type of system, with this high degree of autonomy in targeting, that I will consider in exploring how human control of LAWS might be understood through the HEC.

The Hypothesis of Extended Cognition (HEC)

Cognitive science and the philosophy of cognition offer a useful way to understand meaningful human control of LAWS. Examining how LAWS might extend cognition intersects an existing body of thought about AI, cognitive artifacts, and the HEC. LAWS make for a particularly interesting and ethically charged example of extended cognition that seems yet unexplored. None of the extant LAWS literature considers LAWS through the HEC. Suchman and Weber make a tantalizing reference to Knorr-Cetina's seminal *Epistemic Cultures*, and its implications for subject/object relations,²⁶ but go no further in exploring how LAWS and soldiers might be part of a cognitive system.²⁷ This is the gap I attempt to resolve. Before looking at LAWS specifically, it will help to give an overview of the HEC.

The HEC has an intellectual heritage going back decades. Clark and Chalmers argue that the human mind can and does extend into the physical, material world.²⁸ Their theory rests on functional parity between the roles of internal (neural) and external processes in cognition. They argue against attempts to bound the human mind based purely on where a cognitive process takes place. An alternative argument for the extended mind claim is that our tools often complement, rather than mimic or replicate, the cognitive processes of the biological brain.²⁹ Both arguments reach the same conclusion: that the mind resides not just in the brain. The physical machinery that realizes our cognitive processes and, indeed, our *minds*, includes more than just our neural processes. Our minds can and do sometimes extend into the tools we use, our notebooks, telescopes, hammers, laptops and so on. Although the HEC remains controversial, it is gaining popularity in cognitive science. As Heersmink notes, "The paradigm shift from conceptualizing the mind as a purely internal affair to seeing it as

embodied and shaped by and strongly connected to the environment is well under way."³⁰ I do not attempt to enter fully into the debate on the HEC; it is sufficient to have established that the HEC is a credible theory.

Under the HEC paradigm, LAWS could be understood as artifacts that can extend human cognition, or cognitive artifacts. Heersmink calls cognitive artifacts "human-made, material objects or structures that functionally contribute to performing a cognitive task."³¹ Authors such as Sienknecht have considered the integration of cognitive artifacts into war where these artifacts provide inputs to biological cognitive processes (such as an AI system that analyzes enemy movements and recommends to a human commander a pre-emptive strike).³² A LAWS would instead extend biological cognition into action. If the mind extends into LAWS, as the HEC allows, perhaps this extension remains under human control.

LAWS Extending Cognition

LAWS, as cognitive artifacts, can take on some of the cognitive tasks required to effect the intentions of their designers and operators. To understand how, we need to consider intentions in more detail. Intentions can be hierarchical, existing at various levels of abstraction. A human commander might deploy LAWS with the more abstract, or higher order, intention to disrupt enemy communications. A LAWS could analyze enemy radio traffic, construct a representation of the enemy communications network, and locate and destroy key nodes in it. It might do this by targeting the radios themselves, re-broadcast antennas, or perhaps the fuel that supplies their generators. While operating autonomously in terms of the selection and prosecution of particular targets, such a LAWS is still effecting a human intention. LAWS merely allow humans to focus their conscious intentions and thought at a higher level of abstraction. This is exactly the kind of complementary delegation of cognitive tasks that Heersmink argues characterizes an extended cognitive system: "The human brain develops in an information-rich environment and has to learn how to complement its shortcomings by using the functionalities of artifacts to perform cognitive tasks in such a way that it does not waste expensive internal resources."³³ Hernandez-Orallo and Vold speak of technologies that act as AI extenders, which exist "in a continuum between fully externalized systems, loosely coupled with humans, and fully internalized processes."³⁴ LAWS seem to fall on this spectrum, even without a human in or on "the loop."

An interesting property of advanced LAWS would be their transparency³⁵ to the commander employing them. This lack of conscious awareness may even make a case for understanding LAWS as cognitive extenders. Heersmink comments: "The use of artifacts can be conceptualized along a spectrum of expertise. The first time we use an artifact, it requires a lot of conscious, cognitive effort, but over time, we become better at using an artifact



HMCS VILLE DE QUÉBEC's CH-148 Cyclone, Avalanche, launches flares over the Atlantic Ocean while deployed on Op HORIZON, November 6, 2025.

Photo: Sailor First Class Kyle Maguire, MARPAC Imaging Services, CFB Esquimalt

and its use becomes more proceduralized.”³⁶ Philosopher Michael Wheeler argues that such transparency can be an indication of cognitive extension, but also a cause for concern.³⁷ If systems that extend our cognition become sufficiently transparent to us, we may no longer realize the ways in which their categorizations of the world do not match our own.³⁸ Wheeler writes:

“If a deep neural network application to which I am transparently coupled qualifies as part of my cognitive architecture and thus as part of me, then the classifications in question—classifications that unconsciously guide my behaviour—will be part of what I unconsciously believe to be the case, and thus presumably will have the same status as my more familiar, internally realized unconscious beliefs.”³⁹

His objection is that these machines “may routinely classify the world in ways at potentially damaging epistemic variance with our technologically unaugmented practices.”⁴⁰ This is especially concerning for LAWS employing AI that function as “black boxes” whose inner workings are unknowable to the user. He thus recommends that cognitive technologies be made deliberately non-transparent, similar to calls for keeping a human on the loop for LAWS.

Concerns about cognitive technologies are not new. Socrates worried that writing, as a cognitive technology, acts outside of meaningful human control, claiming: “And once a thing is put in writing, the composition, whatever it may be, drifts all over the place, getting into the hands of not only those who understand it, but equally of those who have no business with it; it doesn’t know how to address the right people, and not to address the wrong.”⁴¹ These words echo modern objections to LAWS interacting with the wrong people in unintended ways. If we accept that the intentions of an author are sufficiently embedded in a written composition that it does not need active human control as it propagates unsupervised into the world, there should be some parity in the degree and type of control we demand over LAWS. While the potential deadly effects of LAWS might limit direct comparison to civilian technology, LAWS are not the only technology whose failure poses a risk of death (i.e. bridges and automobiles).

The HEC, by allowing that the mind might extend into LAWS, calls into question any insistence that a biological brain must be “on the loop” for control. Increasingly, machine learning and AI will permit LAWS to effect not only a specific human intent, taking on a tiny share of cognition, but to effect a general or more abstracted human intent by taking on much more cognitive burden. Thinking of control merely in terms of immediate and active involvement of a biological human brain ignores how we routinely extend cognition into physical artifacts without surrendering control. The ICRC argues that “a weapon system with autonomy in its critical functions prevents the human commander or operator from making the judgements required by IHL [international



A member of The Royal Canadian Dragoons participates in an urban village attack scenario as part of the Basic Tactical Aviation Course (BTAC) at CFB Petawawa on April 4, 2022.

Photo: MCpl Laura Landry, Canadian Armed Forces

humanitarian law] [emphasis added].”⁴² The HEC allows, however, that the mind making these judgements *extends* into LAWS. Under the HEC, a military force could instantiate cognitive processes either in a biological human brain or the physical world, or some mix of the two.

Whether a LAWS carries out human intent may be more important than whether it is under direct and immediate human supervision. The United States 2018 submission to the CCW advances that idea by stating the following: “The key issue for human-machine interaction in the development, deployment, and use of emerging technologies in the area of lethal autonomous weapons systems is ensuring that, when it is necessary to use force, such force is used to effectuate the intentions of commanders and operators.”⁴³ Australia takes a similar view, stating that “the phrase ‘human control’ as used by some in the [Group of Governmental Experts] discussions does not adequately cover the plethora of practical controls or systems utilised by states and their militaries.”⁴⁴ Rather than mandating a human on the loop, Australia instead articulates their own nine-stage system of control applicable to all weapons, human-operated and autonomous.

Implications for Commanders

The autonomy of human subordinates does not entail that they are beyond the control of their commanders. Militaries do not require a commander on the loop watching a human subordinate and authorizing every specific action. James Kraska, of the US Naval War college, argues that there is no responsibility gap with LAWS, as commanders remain ultimately responsible for all the means of warfare that they employ in achievement of their military objectives.⁴⁵ Granted, LAWS and human subordinates are not identical, with human subordinates having accountability and moral agency that LAWS do not.⁴⁶ Despite that disparity, control

of human subordinates might still inform control of LAWS in at least two respects: orders and training.

Commanders give orders that direct the actions of their human subordinates. These orders can include both a task and a purpose. Orders typically refer to the higher commander's intent, including contextual information that allows human subordinates to act in accordance with these intentions, even if the situation changes so drastically that their assigned task is no longer appropriate. A commander's intentions can be effectuated in ways that are opaque to that commander without a loss of control. Even in modern, professional armies with advanced communication, there are examples where subordinates have acted unexpectedly, with no oversight by superiors, to achieve a higher intention.⁴⁷ Such military units are not considered out of control, so why should LAWS be? When appropriate, orders can contain a variety of formal constraints (rules of engagement, boundaries, timings, and reporting requirements) that could have direct analogies for LAWS. There is a growing body of literature that seeks to "assess the trustworthiness of humans and automated systems to decide whether to rely on a respective trustee to perform a certain task."⁴⁸ A human commander might have adequate instrumental trust in LAWS to apply a form of mission command and accept unpredicted actions that still achieve the intent.

The analogy to training humans provides a way to look at human-LAWS interaction and control of LAWS employing AI or machine learning. LAWS using generative models are "trained" on a sample of inputs simulating what they might encounter in operations. This training would provide opportunities for confirmation and validation of LAWS very similar to what is done for (human) military units prior to deployment. Although Verbruggen argues that "there are no techniques in existence that can validate and

verify AI, to ensure that the systems will function as specified and avoid unpredictable behaviour."⁴⁹ This understanding of validation, seeking full predictability, is much stricter than what is applied to human organizations. The Canadian Army (CA) defines confirmation as "an assessment of how well a tactical organization has mastered a particular [battle task standard]."⁵⁰ Validation serves to "verify that a [collective training] program has adequately prepared units or formations to perform the operational tasks to meet specified CA goals."⁵¹ Both are a responsibility of commanders.

A well-trained LAWS might be under control even if it operates outside of human conscious awareness and decision-making similar to the unconscious human execution of drills. In certain military disciplines, reactions and behaviours requiring immediate response are drilled and trained to a point of near unconsciousness. With sufficient practice, this manipulation of a weapon for potentially lethal ends becomes almost transparent. Wheeler describes this as transparency of tool use, writing:

"When we skillfully manipulate equipment in a hitch-free manner, we have no conscious apprehension of the items of equipment in use as independent objects, that is, as something like identifiable bearers of determinate states and properties. Thus, to use Heidegger's most-quoted example, while engaged in trouble-free hammering, the skilled carpenter has no conscious recognition of the hammer, the nails, or the work-bench, in the way that one would if one stood back and thought about them."⁵²

A weapon could be similar to the skilled carpenter's hammer. Being freed from the need to focus consciously on *how* to manipulate the weapon, the human consciousness can focus on more abstract cognitive tasks like what effect this manipulation aims to achieve (i.e. suppression of an enemy sniper). If the training of a human to respond unconsciously does not entail an abdication of meaningful control over lethal force, could the programming or training of an artificially intelligent LAWS also provide control, even if the LAWS operates outside human conscious awareness? Removed from individual decisions about the selection and prosecution of targets, a military commander is not divorced from the application of force, nor from responsibility, but rather is liberated to consider it at a higher level.



Members of HMCS Charlottetown conduct a proficiency flight of the ships Sparrow Uncrewed Aerial System (UAS) during operational patrols in the Mediterranean Sea as Flagship of Standing NATO Maritime Group Two (SNMG2) while deployed on Operation REASSURANCE on July 8, 2024.

Photo: Aviator Gregory Cole, Canadian Armed Forces Photo

Conclusion

The notion of human control of LAWS is complex, and examining it through the HEC can lead to useful ideas and policy. Treating LAWS as cognitive artifacts opens new ways of understanding and exercising human control of LAWS. LAWS that extend human cognition may be under control even without immediate, conscious intervention by a biological human brain. Openness to experimentation and training with LAWS might produce unpredicted benefits for the CAF. Carter and Nielsen argue that generative models can enable artificial intelligence augmentation, writing:

“[Generative models] can be used to explore and discover, to provide new representations and operations, which can be internalized as part of the user’s own thinking. And while these examples are in their early stages, they suggest AI is not just about cognitive outsourcing. A different view of AI is possible, one where it helps us invent new cognitive technologies which transform the way we think.”⁵³

If LAWS are trained in conjunction with their human counterparts, the solutions LAWS employ may in fact provide novel ideas and new cognitive tools that expand the range of human thought. This promise should not be ignored.



Commodore Matthew Coates, Commander of Standing NATO Maritime Group Two (SNMG2), discusses capabilities with drone operators from HMCS Charlottetown upon completion of flying operations with the “Sparrow” Uncrewed Aerial System (UAS) while conducting operational patrols in the Mediterranean Sea while deployed on Operation REASSURANCE on July 9, 2024.

Photo: Aviator Gregory Cole, Canadian Armed Forces Photo

Notes

- Mariarosaria Taddeo, *The Ethics of Artificial Intelligence in Defence* (New York: Oxford University Press, 2024), 181.
- Robert Sparrow, “Killer Robots,” *Journal of Applied Philosophy* 24, No. 1 (2007): 62-77.
- Thomas Simpson and Vincent Müller, “Just War and Robots’ Killings,” *Philosophical Quarterly* 66, No. 263 (2016): 302-322.
- Ingvild Bode and Hendrik Huelss, *Autonomous Weapons Systems and International Norms* (Kingston: McGill-Queen’s University Press, 2022), 9.
- International Committee for Robot Arms Control. Originally found at: <https://www.icrac.net/about-icrac/> (accessed 3 November 2025).
- International Committee of the Red Cross, “The Element of Human Control,” *Meeting of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects* (2018): 1. Originally found at: https://reachingcriticalwill.org/images/documents/Disarmament-fora/ccw/2018/hcp-meeting/documents/ICRC_WP3.pdf (accessed 3 November 2025).
- IEEE, “Reframing Autonomous Weapons Systems,” *The IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems*, 113. Originally found at: https://standards.ieee.org/content/dam/ieee-standards/standards/web/documents/other/lead_reframing_autonomous_weapons_v2.pdf (accessed 3 November 2025).
- Michael Schmitt and Sean Watts, “The Decline of International Humanitarian Law Opinio Juris and the Law of Cyber Warfare,” *Texas International Law Journal* 50, No. 2-3 (2015): 191.
- Australia, “Australia’s System of Control and Applications for Autonomous Weapon Systems,” *Group of Governmental Experts of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects* (2018). Originally found at: <https://reachingcriticalwill.org/images/documents/Disarmament-fora/ccw/2019/gge/Documents/GGE.2-WP2.pdf> (accessed 3 November 2025).
- Group of Governmental Experts on Emerging Technologies, “Chair’s summary - First 2025 session of the GGE on LAWS,” *Group of Governmental Experts of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects* (2025): 7. Originally found at: [https://docs-library.unoda.org/Convention_on_Certain_Conventional_Weapons_Group_of_Governmental_Experts_on_Lethal_Autonomous_Weapons_Systems_\(2025\)/CCW-GGE.1-2025-WP1_-_Chair's_summary.pdf](https://docs-library.unoda.org/Convention_on_Certain_Conventional_Weapons_Group_of_Governmental_Experts_on_Lethal_Autonomous_Weapons_Systems_(2025)/CCW-GGE.1-2025-WP1_-_Chair's_summary.pdf) (accessed 6 October 2025).
- Canadian Army Headquarters, *Advancing with Purpose: The Canadian Army Modernization Strategy*, (2020): 52. Originally found at: https://publications.gc.ca/collections/collection_2021/mdn-dnd/D2-438-2021-eng.pdf (accessed 3 November 2025).
- Human Rights Watch, *Losing Humanity: The Case Against Killer Robots*, (2012). Originally found at: <https://www.hrw.org/report/2012/11/19/losing-humanity/case-against-killer-robots> (accessed 3 November 2025). Although dated, this typology remains influential and was used by Vincent Boulanin and Maakie Verbruggen in *Mapping the Development of Autonomy in Weapon Systems* (Stockholm: Stockholm International Peace Research Institute, 2017), 26, to characterize systems in their dataset.
- Mary Cummings, “Lethal Autonomous Weapons: Meaningful Human Control or Meaningful Human Certification? [Opinion],” *IEEE Technology and Society Magazine* 38, No. 4 (1 December 2019): 20-26. Originally found at: https://publications.gc.ca/collections/collection_2021/mdn-dnd/D2-438-2021-eng.pdf (accessed 28 Feb 2025).
- Missy Cummings, “Automation Bias in Intelligent Time Critical Decision Support Systems,” *American Institute of Aeronautics and Astronautics 1st Intelligent Systems Technical Conference* (20-22 September 2004). Originally found at: <https://arc.aiaa.org/doi/10.2514/6.2004-6313> (accessed 9 July 2025).
- International Committee of the Red Cross, “The Element of Human Control,” *Meeting of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects* (2018): 1.

- Originally found at: https://reachingcriticalwill.org/images/documents/Disarmament-fora/ccw/2018/hcp-meeting/documents/ICRC_WP3.pdf (accessed 6 October 2025).
- 16 Ingvild Bode and Hendrik Huelss, *Autonomous Weapons Systems and International Norms* (Kingston: McGill-Queen's University Press, 2022), 159.
 - 17 The Russian Federation, "Russia's Approaches to the Elaboration of a Working Definition and Basic Functions of Lethal Autonomous Weapons Systems in the Context of the Purposes and Objectives of the Convention," *Group of Governmental Experts of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects* (2018): 3. Originally found at: <https://reachingcriticalwill.org/images/documents/Disarmament-fora/ccw/2018/gge/documents/GGE.1-WP6-English.pdf> (accessed 6 October 2025).
 - 18 Noel Sharkey, "Staying in the Loop: Human Supervisory Control of Weapons." In *Autonomous Weapons Systems: Law, Ethics Policy*, edited by N. Bhuta, S. Beck, R. Geiß, H.Y. Liu and C. Kreß, (Cambridge: Cambridge University Press, 2016), 27.
 - 19 Brian Cox, "Why Binding Limitations on Autonomous Weapons Will Remain Elusive," *Articles of War*, (2022). Originally found at: <https://lieber.westpoint.edu/binding-limitations-autonomous-weapons-elusive> (accessed 6 April 2022), further articulated by the author at a presentation to The Canadian National Group of the International Society for Military Law and the Law of War on 24 Feb 2022, Ottawa (broadcast virtually on MS Teams).
 - 20 DoD Defense Science Board, *The Role of Autonomy in DoD Systems*, (2012): 4. Originally found at: <https://apps.dtic.mil/sti/pdfs/ADA566864.pdf> (accessed 28 Feb 2025).
 - 21 Vincent Boulanin and Maakie Verbruggen, *Mapping the Development of Autonomy in Weapon Systems* (Stockholm: Stockholm International Peace Research Institute, 2017), 20.
 - 22 Vincent Boulanin and Maakie Verbruggen, *Mapping the Development of Autonomy in Weapon Systems* (Stockholm: Stockholm International Peace Research Institute, 2017), 36.
 - 23 United Nations, *Letter dated 8 March 2021 from the Panel of Experts on Libya established pursuant to resolution 1973 (2011) addressed to the President of the Security Council*, (2021): 17. Originally found at: <https://documents-dds-ny.un.org/doc/UNDOC/GEN/N21/037/72/PDF/N2103772.pdf?OpenElement> (accessed 25 October 2025).
 - 24 Jon-Wyatt Matlack, Sebastian Schwartz, and Oliver Gill, *Ukraine's Drone Ecosystem and the Defence of Europe: Lessons Lost Can't Be Learned* (London: LSE, 2025). Originally found at: <https://www.lse.ac.uk/ideas/Assets/Documents/2025-04-05-DRONES-MatlackSchwartzGill-FINAL-WEB-03.pdf> (accessed 7 October 2025).
 - 25 David Hambling, "Ukraine's AI Drones Seek and Attack Russian Forces Without Human Oversight," *Forbes* (17 Oct 2023). Originally found at: <https://www.forbes.com/sites/davidhambling/2023/10/17/ukraines-ai-drones-seek-and-attack-russian-forces-without-human-oversight/> (accessed 21 September 2024).
 - 26 Lucy Suchman and Jutta Weber, "Human-Machine Autonomies," in *Autonomous Weapons Systems: Law, Ethics Policy*, edited by N. Bhuta, S. Beck, R. Geiß, H.Y. Liu and C. Kreß, (Cambridge: Cambridge University Press, 2016), 98.
 - 27 Karin Knorr-Cetina, *Epistemic Cultures: How the Sciences Make Knowledge* (Cambridge: Harvard University Press, 1999).
 - 28 Andy Clark and David Chalmers, "The Extended Mind," *Analysis* 58, (1998): 7-19.
 - 29 Richard Heersmink, "Dimensions of Integration in Embedded and Extended Cognitive Systems," *Phenomenology and the Cognitive Sciences* 14 (2015): 577-598.
 - 30 Richard Heersmink, "Varieties of Artifacts: Embodied, Perceptual, Cognitive, and Affective," *Topics in Cognitive Science* 13 (2021): 574.
 - 31 Heersmink, "Varieties of Artifacts," 580.
 - 32 Dennis Muller, Maurice Chiodo, and Mitja Sienknecht, "Integrators at War: Mediating in AI-assisted Resort-to-Force Decisions," (12 January 2025): 7. Originally found at: https://www.researchgate.net/publication/387976034_Integrators_at_War_Mediating_in_AI-assisted_Resort-to-Force_Decisions (accessed 7 October 2025).
 - 33 Heersmink, "Dimensions of Integration," 582.
 - 34 Karina Vold and José Hernández-Orallo, "AI Extenders: The Ethical and Societal Implications of Humans Cognitively Extended by AI," *AIES '19 Session 9: Human and Machine Interaction*, (2019): 507.
 - 35 Note that "transparency" as used by Wheeler refers to a tool being outside the user's conscious awareness. This differs from the use of transparency in the AI literature where it refers to the ability to understand the interior workings of an AI.
 - 36 Heersmink, "Varieties of Artifacts," 577.
 - 37 Michael Wheeler, "The Reappearing Tool: Transparency, Smart Technology, and the Extended Mind," *AI & Society* 34 (2019): 857-866.
 - 38 Wheeler, "The Reappearing Tool," 857-866.
 - 39 Wheeler, "The Reappearing Tool," 864.
 - 40 Wheeler, "The Reappearing Tool," 864.
 - 41 H. Fowler, *Plato: Phaedrus*, (Loeb Classical Library, 1971): 275e.
 - 42 International Committee of the Red Cross, "The Element of Human Control," *Meeting of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects* (2018): 2. Originally found at: https://reachingcriticalwill.org/images/documents/Disarmament-fora/ccw/2018/hcp-meeting/documents/ICRC_WP3.pdf (accessed 6 October 2025).
 - 43 U.S.A., "Human-Machine Interaction in the Development, Deployment and Use of Emerging Technologies in the Area of Lethal Autonomous Weapons Systems," *Group of Governmental Experts of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects* (2018): 7. Originally found at: <https://reachingcriticalwill.org/images/documents/Disarmament-fora/ccw/2018/gge/documents/GGE.2-WP4.pdf> (accessed 6 October 2025).
 - 44 Australia, "Australia's System of Control and Applications for Autonomous Weapon Systems," *Group of Governmental Experts of the High Contracting Parties to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects* (2018): 5. Originally found at: <https://reachingcriticalwill.org/images/documents/Disarmament-fora/ccw/2019/gge/Documents/GGE.2-WP2.pdf> (accessed 6 October 2025).
 - 45 James Kraska, "Command Accountability for AI Weapon Systems in the Law of Armed Conflict," *International Law Study* 97 (2021): 408-445.
 - 46 Daniele Amoroso and Guglielmo Tamburrini, "Autonomous Weapons Systems and Meaningful Human Control: Ethical and Legal Issues," *Current Roboethics Report* 1 (2020): 189.
 - 47 Douglas MacGregor, *Warrior's Rage: The Great Tank Battle of 73 Easting* (Annapolis: Naval Institute Press, 2009).
 - 48 Markus Langer, Cornelius J. König, Caroline Back, and Caroline Hensing, "Trust in Artificial Intelligence: Comparing Trust Processes Between Human and Automated Trustees in Light of Unfair Bias," *Journal of Business and Psychology* 38 (2023): 493.
 - 49 Maaike Verbruggen, "No, Not That Verification: Challenges Posed by Testing, Evaluation, Validation and Verification of Artificial Intelligence in Weapon Systems," in *Armament, Arms Control and Artificial Intelligence: The Janus-Faced Nature of Machine Learning in the Military Realm*, edited by Thomas Reinhold, and Niklas Schörnig, Springer International Publishing AG, 2022, *ProQuest Ebook Central*. Originally found at: <http://ebookcentral.proquest.com/lib/cvlibrary-ebooks/detail.action?docId=7108384>. Created from cvlibrary-ebooks on 2025-07-09 18:36:43, p. 242.
 - 50 Commander Canadian Army, *TRAINING FOR LAND OPERATIONS*, (2014): 6-3-11.
 - 51 Commander Canadian Army, *TRAINING FOR LAND OPERATIONS*, 6-3-12.
 - 52 Wheeler, "The Reappearing Tool," 859.
 - 53 Shan Carter and Michael Nielsen, "Using Artificial Intelligence to Augment Human Intelligence," *Distill* (2017). Originally found at: <https://distill.pub/2017/aia> (accessed 3 November 2025).