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**Weaponising Neurotechnology:
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Gregor Noll

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Weaponising Neurotechnology: International Humanitarian Law and the Loss of Language

Gregor Noll*

Abstract

Are operators of weapon systems which draw on neuroscience, or their commanders capable of applying IHL? Only at the price of a decision review system that would be so fundamental as to eradicate the temporal advantages neuroweapons create in the first place. To be meaningful, this review system would need to take the metaphysical foundations of neuroweapons into account.

A. Leif and neuroscience

I shall start this account with Leif: a 73-year old farmer from the municipality of Markaryd in Southern Sweden. In the winter of 2012, I spent a week with him at Lund University Hospital, where we both successfully underwent surgery: six days in a four-bed ward in a large department on the 11th floor of the Western wing of the Hospital's central building, and a 48-hour cycle in the operation theatre and the intensive care unit. Leif suffers from Parkinson's disease. I think 'suffers' is more than a figure of speech here. When he was off his usual medication in conjunction with his surgery, I could perceive quite literally how the return of Parkinson's tremor imposed suffering of unmitigated violence on him.

On the Monday of that week, the surgical team implanted two probes, a couple of centimetres long, in Leif's brain, and connected them with subcutaneous wiring to a pulse generator in Leif's chest. Like a pacemaker, this pulse generator is designed to emit small currents, with the important difference that it intervenes in the brain's rather than the heart's workings. The surgical team's intervention took eight hours, leaving Leif appreciably weakened when I saw him entering the intensive care unit.

On Wednesday, upon our return to our four-bed ward, a specialised nurse came to see Leif and to turn on the pulse generator with a small remote control which reminded me very much of consumer electronics. After a rudimentary programming of the strength and frequency of the electrical pulses, both left the room: Leif shuffling forward with his wheeled walker, supported by the nurse who had linked her right arm into his. I had gone back into a dozing state of mind for perhaps ten minutes

when an agile, wirily man rushed into the room, stopped at an empty bed, and described a joyful and pointless curve in the air with his right leg. Lazarus transformed: no walker, no nurse, nothing but motion. Now the nurse entered the room too: 'Leif', she said, breathing audibly, 'I am not quite content with your left turns'.

I was, of course, deeply impressed. Despite the fact that Leif's left turns required small adjustments on the remote control, soon to be handed over to him, so that he could steer the *alter ego* of his brain's neuronal firings, he was dramatically improved compared to his pre-surgery state. This lifted the spirits of all occupants of our four-bed ward: if they could fix Leif, they could surely fix us, too. That said, we all knew that the technology used with Leif, Deep Brain Stimulation or shortly DBS, is about the suppression of symptoms rather than the curing of diseases. In short, the remote control governs the strength and frequency of an electrical current that is sent from the pacemaker to the probes in Leif's head. The probes emit it in a particular area of his brain, and thus counteract those neuronal signals which cause the tremor otherwise incapacitating Leif. The medical, or rather biological, reasons why this method works are not understood; still, it works.

But in the coming days, it emerged that Leif's improvement was a trade off. While his movements were articulated, his speech was less so: it was increasingly hard to follow his brief comments during lunch conversations. A fellow patient well-versed in the literature on DBS informed me that this was normal, and that the remote control could be used to temporarily turn off the system before conversation situations, which allowed Leif to speak more clearly at the price of re-emergent tremor. Why is it that motor control is opposed to the articulation of language? If only by a chance of sorts, the mind-body problem appeared to manifest itself here, that is, the question how mental states relate to physical states.

After a few further days at home, I happened to read an article in the *Guardian*, which reported on military researchers' interests in neuroscience as a means of augmenting the performance of one's own soldiers, or of degrading that of the enemy.¹ I was

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taken aback by the examples given: weak currents induced into the brain by a mesh of electrodes in order to improve the ability of test persons to detect improvised explosive devices, or, on a more intrusive level, the prospective integration of the human brain into a weapon system. In this I recognised the same class of electrochemical technology from which Leif had benefited, and it surprised me that I had not even thought about ethically inverse applications of this type of empirical knowledge back at the hospital. What I experienced in a complete reversal of the enthusiasm triggered by Leif's liberation from his walker was the problem of dual use: delivering a technology serving life is potentially bought at the price of delivering a technology serving death – another trade off.

In the year that has passed since then, I have attempted to grasp the significance of neurotechnology for the development of arms (Section B). In parallel, I tried to understand how a question could be formulated from the perspective of international humanitarian law (IHL) that would capture the complexity of what I will call neuroweapons. This question, formulated in Section C and underlying the remainder of the text, is whether operators of weapons systems drawing on neuroscience, or their commanders, are capable of applying IHL. Section C first explains how rapid processing is traded off against consciousness, and why this might be a problem for IHL. Second, it shows that some scholars, whether from law or from other disciplines, react rather optimistically to the promises of neuroscience. Third, I try to take that optimism to its extreme by sketching the development of an IHL software that could be integrated into future weapons systems, automatising judgements on whether a certain conduct is in conformity with IHL norms or not. This enables me to ask what would be lost if we were to use such a machine. Section D answers this question from a micro-perspective, focusing on the cognitive unity of the human being. It draws on the critique of neuroscience as a degenerate form of Cartesianism that has been formulated within analytical philosophy. Section E is devoted to the loss of language, which leads me to consider the work of the German philosopher Martin Heidegger. In the concluding Section F, I suggest that the 'nature' of man as reflected by neuroscience risks to undermine the ability to apply IHL in the use of neuroweapons.

B. What are neuroweapons?

¹ I Sample, 'Neuroscience could mean soldiers controlling weapons with minds', *The Guardian*, 7 February 2012. The background to the Guardian article was the launch of a report by The Royal Society that reflected how neuroscience in defence applications might affect the laws of armed conflict. The Royal Society, *Brain Waves 3: Neuroscience, conflict and security*, (The Royal Society, 2012).

Armaments are fantasies of future conflicts. They reflect our beliefs of what it means to be a human being in that future.

Arms development in general follows a temporal logic of surprise: being first with the latest. My main example of neuroscientific applications in the military domain is very literally about acceleration. In a great number of battlefield situations, the human brain is actually faster than a computer when it comes to perceiving threats, yet a computer is faster than a human being in calculating countermeasures. Obviously, those militaries combining the two – human perception and machine calculation – will gain an accumulated temporal advantage over those who do not. As I will illustrate in what follows, time competes with conscious decision-taking.

Since 11 September 2001, the operating hours of intelligence, surveillance and reconnaissance missions flown by the US Air Force have gone up by 3,100 per cent, with Unmanned Aerial Vehicles (UAVs) accounting for most of the increase.² As of 2011, the Air Force has to process 1,500 hours of full-motion video and 1,500 still images every day.³ As there are not enough humans available to process the data, Michael Donley, the secretary of the Air Force, described the situation as ‘unsustainable’.⁴

So the US has made enormous investments into global intelligence gathering that it cannot exploit due to lack of manpower. It is recognised that machines can only replace some aspects of human cognition, as I will argue below. It is a reasonable expectation that there will be a massive military interest in a neuroscience that promises to make human cognition automatically exploitable. As an expansion of staff matching the expansion of data is so expensive as to be unlikely, neurotechnology will be a strategically important tool as a remedy for the attention scarcity described by Donley. Of course, Defense Advanced Research Projects Agency (DARPA) is a major beneficiary of the US President’s April 2013 initiative to invest into brain research.⁵

2 E Bumiller & T Shanker, ‘War Evolves with Drones, Some as Tiny as Bugs’ *New York Times*, 20 June 2011, p. A 1. Available at <http://www.nytimes.com/2011/06/20/world/20drones.html?pagewanted=2&ref=unmannedaerialvehicles&r=0> (last visited 17 October 2013).

3 Ibid.

4 S Ackerman, ‘Air Force Chief: It Will Be “Years” Before We Catch Up on Drone Data’, *Wired*, 4 May 2012. Available at http://www.wired.com/dangerroom/2012/04/air-force-drone-data/?utm_source=Contextly&utm_medium=RelatedLinks&utm_campaign=MoreRecently (last visited 17 October 2013).

5 DARPA plans to direct funds of USD 50 million for its 2014 projects under the President’s BRAIN Initiative. ‘DARPA plans to explore two key areas to elicit further understanding of the brain. New tools are needed to measure and analyze electrical signals and the biomolecular dynamics underpinning

I believe that neuroweapons are the logical sequel to UAVs, and the debate on the ‘autonomy’ of the latter prepares the ground for the acceptance of neurotechnology in the development of weapons. While currently one operator is needed to control a single UAV, developments take place that will allow a single operator to control a swarm of UAV in the future. Consequently, there will be a strong case for neuroscientific enhancement of the cognitive capabilities of that operator. Today, all the talk is about drones, while we should be talking about the neurotechnology that will follow in the wake of their deployment.

But let me approach the use of neurotechnology step by step. Putting a computer-aided weapon into the hands of a soldier engaged in, say, urban warfare, is one rudimentary way of combining man and machine. In this initial scenario the soldier still has to process the information gathered from perception and form out of it what we tend to cast as a conscious decision on the course of action she will be taking. Consider that the soldier perceives a threat in the form of another person on the battlefield. Is that person really a member of an allied force? Or is that person a civilian, protected by international humanitarian law? Friend or foe, civilian or combatant: the recognition of status is a complex activity we assume to take place in conscious human reasoning. Recognition adds an iterative trait to sheer cognition, on the assumption that the iteration is used to match what is being cognized with some set of criteria. Ideally, it will at least retrospectively be possible to reconstruct and justify the decision taken by the soldier in human language.

The problem with this kind of rudimentary man-machine combination is that it costs time.

Consider another scenario, in which sensors mounted on a military jet aircraft register an incoming missile. A computer on board the aircraft calculates defensive measures and launches decoys diverting the missile away from the aircraft. This is an autonomous system, which is based on a sensor device detecting the UV light emitted from the missile plume.⁶ Perception of that particular form of UV light in that particular situation equals the decision to mount countermeasures. While my first example separated cognition and re-cognition, that is, the perception of a potential threat and the ascription of status to that threat, my second example has no need for a

brain function. Researchers will also explore, abstract and model the vast spectrum of brain functions by examining its incredible complexity.’ DARPA Press Release, 2 April 2013. Available at <http://www.darpa.mil/NewsEvents/Releases/2013/04/02.aspx> (last visited 17 October 2013).

6 For a description, see e.g. J-M Guhl, ‘NATO EMBOW XIII: Learning How to Deal With the Manpads Threat’, *Defence Review Asia*, 27 October 2011. Available at <http://www.defencereviewasia.com/articles/130/NATO-Embrow-XIII-learning-how-to-deal-with-the-Manpads-threat> (last visited 16 November 2013).

separate recognition process. For autonomous systems, in which the machine decides, cognition suffices. What characterises the missile-contra-jet scenario is that it opposes two of the fastest weapons used in fighting wars. When time is short, defense engineers seek to exploit opportunities for omitting processes of recognition.

Let us move to a third scenario in which human skills and machine skills are integrated rather than combined. This scenario is much debated in the literature on future uses of military neuroscience. Imagine a reversal of Leif's treatment: rather than sending electrical currents into a partly dysfunctional brain, we siphon off electrical currents from an able-bodied person looking at a piece of enemy territory and feed them directly into a weapons system. Imagine a drone operator attached to an EEG that passes on particular electrical signals to a computer which then opens fire on a target. Why would there be a military interest in doing that?

Human beings are capable of processing images in parallel. This enables us to detect targets and classify them in 200 milliseconds, much faster than we can become conscious of what we see,⁷ and much faster, and this is the point, than a computer could perform the same task. On a subconscious level, the brain reacts to such perceptions by sending a readiness signal to relevant parts of the motor system. This signal is received a significant number of milliseconds earlier than any conscious decision is formed in the brain and passed on as a signal by its neuronal networks. Why does this matter? A military mastering the integration of that subconscious weapons signal into weapon systems would be able to save time by bypassing human consciousness. Such a military would possess an across-the-board superiority over enemy forces still relying on the traditional pathway from human perception over human consciousness to a human command to the weapons system. I will call 'neuroweapons' those weapons systems that a) integrate neuronal and synaptic activities of the human brain into a weapons system and b) eliminate the element of human consciousness before engaging a target.

In our three scenarios, is it the human being or the machine that decides on engaging the target or not? I go back to the first scenario, in which it was the human being who decided on targeting. In the second scenario, it was the machine, provided we leave the human being commanding the deployment and activation of the system outside our frame. Command responsibility can obviously serve as a strategy to propose that the second scenario 'ultimately' is about a human decision. But, as we will see, it is

⁷ See PS Churchland, *Neurophilosophy: Toward A Unified Science Of The Mind-Brain*, (1989) 35-36.

worth our while to struggle with the third scenario without resorting to command responsibility right away.

Systems integrating the human brain with machines are known as Neural Interface Systems (NIS), Brain-Machine-Interfaces (BMI) or Brain-Computer Interfaces (BCI).⁸ In the military domain, such systems are currently developed for a variety of applications. Two Iranian researchers have recently proposed a BCI system that detects sleepiness in military sentinels by monitoring soldiers' neuronal activities through EEG signals online.⁹ As warfighters are required to remain active for very long periods in contemporary contexts, sleepiness is a major practical issue. 'Silent Talk' permits soldiers to communicate through EEG signals of intended speech rather than through actual speech or body gestures.¹⁰ This might serve the needs of Special Forces or help to overcome the problem of extremely noisy battlefield environments. Research has shown that brain signals can be used to predict spoken or imagined words, yet it seems that practical questions remain to be answered before a military communication system drawing on silent talk can be built.¹¹ Another is a DARPA proposal for a 'Cognitive Technology Threat Warning System', featuring neurotechnologically enhanced binoculars that can quickly respond to a subconsciously detected target or threat.¹² A third one is tele-presence, allowing a soldier at one location to be sensing and interacting at another location through a BMI.¹³

Will neuroscience be used to break down the massive image and data overload generated by UAVs? Recently, four US researchers reported their attempt to integrate automated neural processing of visual information into a US Army simulation environment to detect targets. Touryan et al. used the environment of a ground vehicle crew station to test whether the human brain can successfully identify targets 'automatically' by offering neuronal response to video footage. They reported that '[o]ur results indicate the potential for significant benefits to be realized by

8 BCIs are a subcategory to BMIs.

9 S Resalat & F Afdideh, 'Real-time monitoring of military sentinel sleepiness using a novel SSVEP-based BCI system', *2012 IEEE EMBS Conference on Biomedical Engineering and Sciences (IECBES 2012)*, 740-5.

10 I Kotchetkov et al., 'Brain-Computer Interfaces: Military, Neurosurgical, and Ethical Perspective', *Neurosurg Focus* Vol. 28, May 2010, 1-6, at 4, with further references.

11 X Pei, J Hill & G Schalk, 'Silent Communication', *IEEE Pulse*, January/February 2012, 43-46, at 45. Pei, Hill and Schalk used electrocorticographic signals. Tracking these signals requires neurosurgical implantation. For practical military uses, a system building on non-invasive method such as electroencephalography would need to be developed. The authors say as much in their conclusions (46).

12 Ibid.

13 Ibid.

incorporating brain-computer interface technology into future Army systems.’¹⁴ This illustrates that neurotechnological targeting applications are currently making their way towards deployment in actual combat.

Finally, one recent DARPA-supported study by Stoica et al. suggests that decisions on targeting selection might be made through a BCI that pools a collective of operators, rather than dealing with operators one by one.¹⁵ Neural signals of a number of operators are fed into a computer and then processed. The study has shown that the performance of such multi-operator BCIs is superior to that of single-operator BCIs.¹⁶ The latter study is perhaps the most striking indication that the unconscious perception of human beings as mirrored in their neural signals is about to be integrated collectively into a single computing superstructure. While the massive expansion of UAVs has led to single operators now operating ‘swarms’ of UAVs, it appears that BCIs operating ‘swarms’ of human beings providing neural signals is no longer an unrealistic thought.

BMIs confront us with our assumptions on mind and body: are they two separate entities, or is one to be explained through the other? If so, is it the mind or the body that is calling the shots? Or a particular combination of both? Do we need a God-like entity to turn our assumptions into a comprehensive explanation?

These issues are known as the mind-body problem in the philosophy of mind. I am afraid this is no philosophical sideshow in my argument. It is about what it means to be human. And so is international humanitarian law as an attempt to give meaning to the human in and through warfare. The task we have – each of us, individually – is to think about the meaning of being human. Being cognisant of neuronal processes in our brain is only one preliminary aspect in this work of recognition.

14 J Touryan, AJ Ries, , P Weber, & L Gibson, ‘Integration of automated neural processing into an army-relevant multitasking simulation environment’ *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 8027 LNAI (2013), 774-782.

15 A Stoica, A Matran-Fernandez, D Andreou, R Poli, C Cinel, Y Iwashita& C Padgett, ‘Multi-brain fusion and applications to intelligence analysis’, *Proceedings of the SPIE - The International Society for Optical Engineering*, v 8756, p 87560N (8 pp.) (2013). Here is the abstract:

In a rapid serial visual presentation (RSVP) images are shown at an extremely rapid pace. Yet, the images can still be parsed by the visual system to some extent. In fact, the detection of specific targets in a stream of pictures triggers a characteristic electroencephalography (EEG) response that can be recognized by a brain-computer interface (BCI) and exploited for automatic target detection. Research funded by DARPA's Neurotechnology for Intelligence Analysts program has achieved speed-ups in sifting through satellite images when adopting this approach. This paper extends the use of BCI technology from individual analysts to collaborative BCIs. We show that the integration of information in EEGs collected from multiple operators results in performance improvements compared to the single-operator case.

16 Ibid. I find it incongruous to use the term ‘operators’ for the human beings, who offer up their neural signals to this particular BCI.

IHL has a bearing on the choice of targets and the way they are engaged. For all three scenarios, the relevant IHL rules can be reduced to two. The first is the rule of distinction: the parties to a conflict ‘shall at all times distinguish between the civilian population and combatants, and between civilian objects and military objectives, and accordingly direct their operations only against military objectives’.¹⁷ The second is the principle of proportionality. In Rule 14 formulated in the Customary International Law Study commissioned by the ICRC, it is expressed as follows:

Launching an attack that *may be expected* to cause incidental loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof, which would be *excessive in relation* to the concrete and direct military advantage anticipated, is prohibited.¹⁸

As ‘[t]he use of weapons which are by nature indiscriminate is prohibited’¹⁹, it would make no sense to develop neuroweapons if they were just that. Today, we are not in a position to study the functioning of deployed weapon systems incorporating neurotechnology, and thus it may seem overly speculative to ponder whether they are ‘by nature indiscriminate’. However, Article 36 API obliges states to anticipate the functioning of a weapons system and to determine the legality of its future use:

In the study, development, acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party.

Article 36 API is formulated broadly to cover weapons as well as other means or methods of warfare. To the extent that neurotechnology informs future weapons

17 Art. 48 Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts, 8 June 1977 (hereinafter API). It is widely held that this norm is part of customary IHL. Rule 1 of Henckaerts and Doswald-Beck’s study on customary IHL corresponds to the content of article 48 API. J-M Henckaerts & L Doswald-Beck, *Customary International Humanitarian Law*, (Cambridge UP, 2005) (hereinafter CIHL).

18 Rule 14, CIHL. Available at http://www.icrc.org/customary-ihl/eng/docs/v1_rul_rule14 (last visited 17 October 2013) (emphasis added). See also Art. 51.5.b API

19 Rule 71 CIHL. Available at http://www.icrc.org/customary-ihl/eng/docs/v1_rul_rule71 (last visited 16 October 2013).

systems, states are under an obligation to consider how the resulting weapons system would relate to IHL obligations.²⁰

However, for obvious reasons, states are keeping the content of reviews under article 36 API confidential.²¹ So we do not know to what extent the impact of neurotechnology on the legality of using future weapons systems is considered by states, and with what results.

Is there any doctrinal writing on the compatibility of neurotechnologically enhanced weapons systems with IHL? While there are a number of texts on neuroscience and the law, writings on its relation to IHL are scant. A good entry point is Stephen E. White's 2008 note entitled 'Brave New World: Neurowarfare and the Limits of International Humanitarian Law'.²² The cadence of arguments emerging from White's note is as follows. First, White suggests that new technology seems to withstand challenges of illegality under IHL. I do not think this is necessarily true. Second, White finds that potential war crimes committed with BMI weapons systems will be impossible to prosecute due to the *mens rea* requirement. On this, I fully agree. Third, White believes that impunity should be avoided by drawing on command responsibility for both military superiors and the developers of weapons systems. I do not agree with him on that point.

What I miss in White's work is a more fundamental question: is the operator of a BMI weapons system *capable* of applying IHL?

20 The concept of 'weapons systems' seems to be sufficiently broad to mandate considerations of the impact new technologies have on state obligations under IHL in armament development:

The US DOD Law of War Working Group has proposed standard definitions, pursuant to which the term "weapons" refers to "all arms, munitions, materiel, instruments, mechanisms, or devices that have an intended effect of injuring, damaging, destroying or disabling personnel or property", and the term "weapon system" refers to "the weapon itself and those components required for its operation, including new, advanced or emerging technologies which may lead to development of weapons or weapon systems and which have significant legal and policy implications. Weapons systems are limited to those components or technologies having direct injury or damaging effect on people or property (including all munitions and technologies such as projectiles, small arms, mines, explosives, and all other devices and technologies that are physically destructive or injury producing)."

See W. Hays Parks, Office of The Judge Advocate General of the Army, 'Weapons Review Programme of the United States', presented at the Expert Meeting on Legal Reviews of Weapons and the SIrUS Project, Jongny sur Vevey, Switzerland, 29-31 January 2001.

The quote is taken from ICRC, *A Guide to the Legal Review of New Weapons, Means and Methods of Warfare. Measures to Implement Article 36 of Additional Protocol I of 1977* (2001), 9, note 17.

21 See JD Fry, 'Contextualized Legal Reviews for the Methods and Means of Warfare: Cave Combat and International Humanitarian Law' 44 *Lolum. J Transnat'l L.* (2005-06), 453-519, at 473-480 for an overview of review procedures in seven states. Nine of the 158 parties to API have instituted formal review procedures, and the content of reviews is usually not made public.

22 SE White, 'Brave New World: Neurowarfare and the Limits of International Humanitarian Law', *Cornell International Law Journal* 41.1 (2008), 177-210.

Why do I reject White's position that command responsibility is helpful? The legal institution of command responsibility is modelled on ideas of human subordinates, equipped with consciousness and thus the potential to breach IHL. As long as we assume that the BMI weapons system operates a human being rather than being operated by him, there is no subordinate whose crimes – real or potential – could provide the base for command responsibility. White must believe that, too, as he avows that operators are not involved to such a degree that their *mens rea* can be established.²³ Therefore, White's hopes for command responsibility are regrettably self-contradictory.

Let us revert to our third scenario and ask the question I miss in White's paper: is a state capable of applying IHL when employing a future BMI weapons system? I pursued two different paths when probing for an answer.

Here is the first:

Experts regularly explain the difference between a human being and a computer by suggesting that human beings are characterised by imagination and reason, while computers are characterised by calculation and logic. In this context, I would like to emphasise two aspects of the norm of proportionality. First, it is about the *expectation* of loss. This presupposes the capability of imagination. Second, it is about a *relationship of excess* between loss and gain. This presupposes the capability of reasoning on incommensurable elements – civilian loss and military advantage – and of assigning value to them.²⁴

The human input into a NIS/BMI weapons system will be at the subconscious level, if it is to outperform enemy systems relying on human consciousness. It is *prima facie* hard to fathom how imagination and reasoning needed to apply IHL could be located at the subconscious level and operate with the requisite speed. Speedy unconscious cognition is one thing. To claim that there can be speedy unconscious re-cognition of legitimate targets is quite another. Therefore, IHL cannot be applied by operators of BMI weapons systems, unless the deploying military takes the time for a human review of all targeting decisions through a superior before the target is engaged. The more autonomy is given to the weapons system under such a review mechanism, the less it will be able to apply IHL.

23 White (2008), 200-201.

24 IHL writers generally tend to suggest that civilian loss and military advantage are incommensurable. That said, they maintain their faith in the usefulness of proportionality reasoning in IHL nonetheless. See G Noll. 'Analogy at War: Proportionality, Equality and the Law of Targeting' *Netherlands Yearbook of International Law* 43 (2013): 205-230, at 210 for further references.

To give this understanding some traction in Western traditions of thought, the mythical narrative on the Golem of Prague may come in well.²⁵ The Golem is a homunculus figure, manufactured by man and combining human and superhuman features. In the particular case, Rabbi Löw of Prague was said to have created the Golem with its superior strength in order to defend the Prague Jewry from the risks of an impending pogrom. Certain renderings of the myth cast the Golem as incapable of speaking, strangely echoing the side effects of treating Parkinson's disease by DBS. In the end, the Golem proved incapable of observing the foundational norms of its mission – to defend the Jewish inhabitants of Prague threatened by persecution – and turned indiscriminately violent. In this narrative, the capability to observe the law (of self-defense, as it were) is at least weakly linked to possessing language. With more autonomy allocated to the Golem, it seems, the Golem will be less able to apply the law.

Here is the second path.

Let me illustrate how the mind-body problem is inadvertently acted out in the introduction to a 2009 article on 'Law and the Revolution in Neuroscience: An Early Look at the Field' by Henry T. Greely:

Everything that you just perceived, saw, heard, felt, or contemplated – as far as we can tell it is all neurons giving off and taking up neurotransmitters. And that's it. The entire universe that exists within each of our skulls seems to be the product of these electrochemical reactions. That's all. It is a daunting vision and one that has taken me a long time to accept. But I have ultimately become convinced of its truth, largely because *there doesn't seem to be any place for anything else to be*. Certainly modern neuroscience works on the premise that our minds, our thoughts, our perceptions, our emotions, our beliefs, our actions, are all generated by our brains, by the roughly 100 billion physical neurons and their several hundred connections (or synapses) per neuron.²⁶

25 A Wöll, 'Der Golem: Kommt der erste künstliche Mensch und Roboter aus Prag?', in M Nekula, W Koschmal & J Rogall (eds), *Deutsche und Tschechen. Geschichte – Kultur – Politik*, (Beck, 2001), 235–245.

26 HT Greely, 'Law and the Revolution in Neuroscience: An Early Look at the Field.' *Akron Law Review* 42.3 (2009): 687-715 (emphasis added).

Although Greely somewhat caricatures the richness and indeterminacy of the debate on the significance of neuroscience, the introduction is beautiful in the way it squarely, perhaps naïvely, begs the question of the *place* of language, and, in extension, law. If all we have is the firing of neurons in neural networks, who could point out a place where law is in its own and from which it can be applied?

This made me think about the elective affinity between Greely's purportedly mainstream view of the human and that of transhumanist fringe thinkers who are discussing the uploading of human consciousness onto a computer. This, they think, would liberate the mind from the body and allow that mind to achieve immortality, moving around from system to system. Greely emphasises the neurons giving off and taking up neurotransmitters. To the extent that those signals can be mapped and expressed in a binary code, the distance between a mainstream law professor and a fringe transhumanist suddenly decreases dramatically.²⁷ I say this with the greatest respect for Professor Greely and the transhumanists – we dearly need their positions to extrapolate the thinking at work in the development of neuroweapons.

For those who believe with Professor Greely that electrochemical reactions give us a full causal explanation of whatever we 'saw, heard, felt or contemplated', it should be good news that neuroscience can map them to a fair extent.²⁸ Consider the following projection.

In the first phase, we repeatedly assemble a large group of IHL experts from all continents with a superior track record in applying IHL to a broad variety of combat situations. We link them up to devices mapping their brain activity and their eye movements. We take them through a large number of audiovisual targeting simulations in which IHL norms have to be applied to specific weapons system in

²⁷ Nick Bostrom has defined transhumanism as follows:

1) The intellectual and cultural movement that affirms the possibility and desirability of fundamentally improving the human condition through applied reason, especially by developing and making widely available technologies to eliminate aging and to greatly enhance human intellectual, physical, and psychological capacities.

2) The study of the ramifications, promises, and potential dangers of technologies that will enable us to overcome fundamental human limitations, and the related study of the ethical matters involved in developing and using such technologies

N Bostrom, *The Transhumanist FAQ* v. 2.1., (Oxford, 2003), 2.

²⁸ I have used Henry Greely's text to illustrate how a particular type of neuroscientific research is being transposed into legal scholarship without asking critical questions about the philosophical assumptions that underpin it. Greely equals human attributes – seeing, hearing, feeling and contemplating – with activities of the brain. So do a number of distinguished neuroscientific researchers. However, serious critique has been levelled against that particular aspect of their work. M Bennett & P Hacker, 'Selections from *Philosophical Foundations of Neuroscience*', in M Bennett, D Dennett, P Hacker and J Searle, *Neuroscience and Philosophy. Brain Mind and Language* (Columbia UP, 2007), 3-48 at 7 and 17.

specific combat situation. Both the brain activities²⁹ and eye movements as well as the legal judgements verbalised by the experts are recorded. We do the same mapping exercise on a randomly composed non-expert group. From a comparison of the two data sets, we derive the patterns of decision-taking and the range of outcomes that characterise IHL experts. These are then coded so that they can be ‘understood’ by the computer of the weapons system.³⁰ The weapons system is now running IHL software. In a second phase, the experts and the IHL software are looped. In a large number of simulations, the experts follow the decision-taking by that IHL software and correct it where they think it errs. Now the software is ready for deployment. It processes standard IHL issues much faster than any human being would. When it encounters atypical scenarios, it automatically alerts a military commander advised by an IHL expert who then take over. Save for that emergency delegation to humans, it is functionally analogical to the automatic anti-missile system mounted in the military jet in my second scenario.

That projection is entirely of my own invention, and I hasten to emphasise that it is not something I propagate. In this projection, IHL is transformed into something empirically observable. It is also run through Greely’s material source of truth, namely the neuronal networks of IHL experts. Returning to my question whether a state employing a BMI weapons system would be capable of applying IHL, my invention would allow an answer in the affirmative.

Is this a completely hypothetical case? Not necessarily. By late 2013, BAE plan to have conducted test flights with Taranis, a radar-evading supersonic unmanned jet fighter.

29 By scanning test persons with functional Magnetic Resonance Imaging (fMRI), those areas of the brain can be made visible in which increased metabolic activity takes place. These areas appear as ‘illuminated’ in scans. The method localises processes in the brain, and allows for the association to particular cerebral functions, e.g. logic, intuition or creativity. While I take Philip Clapson’s point that current fMRI imaging “has no identified method by which correlations can be made between what a subject experiences and what is illuminated”, this is not what I am after in my hypothetical BMI. Rather, the scanning of brain activities is merely one way of establishing some aspects of the IHL analysis carried out by the test persons. These are mainly the sequence of formal rule application and judgmental activity. P Clapson, ‘The Theory of Brain-Sign: A Physical Alternative to Consciousness’, 53 *Activitas Nervosa Superior* (2011), 101-19, at 103.

30 I am aware that this description is cryptic and gives short shrift to issues within Artificial Intelligence that would arise in developing this software. In my hypothetical scenario, the optimal behaviour of a weapon system in a given situation would be of interest. Should it strike or not? How should it strike? A genetic algorithm, modelled on natural selection, might offer itself to heuristically provide answers. The decision-making process of IHL would be one constraint amongst many that such a system could be programmed to take into account. The optimal behaviour derived from the software would then be carried out in real life, with a minimum of temporal delay. This system is one of Artificial Life (featuring bottom-up ‘breeding’), rather than Artificial Intelligence (featuring top-down designing). That, in turn, brings us back to the problematic normativity of ‘natural laws’ at work in evolution, which genetic algorithms mimic. Once this normativity has outcompeted that of the spoken and written law, a major paradigm shift would have taken place.

In theory, advanced programming could allow Taranis and competitor UAVs to decide on their own whether or not to bomb a convoy of vehicles or a factory. BAE insists Taranis will never be left to make such decisions, noting, ‘any future in-service systems based on such a concept design will be under the command of highly skilled ground-based operators who will also be able to remotely pilot the aircraft.’³¹

The question is whether the ‘advanced programming’ alluded to by the *Financial Times*’ defense correspondent already comprises a rudimentary IHL functionality, or whether the application of IHL will be the exclusive domain of ‘highly skilled ground based operators’ and the commanders supervising them.

Why should we not adopt a neurotechnologically enabled IHL software? What would be lost? What would its introduction mean for IHL and its relationship to the waging of war? By asking these questions, I want to challenge my own assumption that there should be a place for language, politics and the law in future warfare.

D. The loss of perceptual and cognitive unity

So what would be lost if we were to adopt a neuroweapons system incorporating IHL software along the lines I described above? Would that loss matter?

By pressing the remote control, Leif may alter neuronal states in his brain. He is able to choose between motoric and linguistic ability, and this choice, as well as its trade-offs, are conscious to him. The same holds for users of simple BCIs, such as neurotechnological binoculars, yet the trade-offs might not be as manifest as in Leif’s case. A BMI that pools the perception of a group of individuals is different, though. With the growing complexity of neurotechnological systems, and their growing integration into distributed situation awareness, the trade-offs are increasingly opaque. There is not one individual human being whose consciousness hosts the experiences of both the advantages and the downsides of a system resting on pooled individuals.

So one loss I would like to consider is that of perception and cognition being united in one single human being. Yet all depends on how we understand ‘perception’ and ‘cognition’ and the interplay between them. I might believe that cognition takes place primarily in the neural system. In that case, neuroweapons will not worry me. Or I

31 C Hoyos, ‘Development of autonomous UAVs raises ethical questions’, *Financial Times*, 17 June 2013, Aerospace section, 3.

might believe that cognition, or at least a certain kind of cognition, is not reducible to the neural system. I will also believe, then, that consciousness and language play important roles in cognition. In that case, I will find neuroweapons extremely troublesome. They will trouble me because they disrupt the integration of perception and cognition in the human body and place each of them in separate individuals, or even groups of individuals. I might find the normative effects of this separation to be unfathomable.

And this is the very choice staged by the dialogue between neuroscience and philosophy. An important stream in neuroscientific research is based on what critics have identified as a 'degenerate form of Cartesianism'.³² In this stream, predicates formerly ascribed to the mind are now ascribed to the brain. 'These scientists', Bennett and Hacker state, 'proceeded to explain human perceptual and cognitive capacities and their exercise by reference to the brain's exercise of *its* cognitive and perceptual capacities'.³³ While I cannot say exactly how dominant this stream is within neuroscience³⁴, I have noted reverberations of degenerate neuroscientific Cartesianism in the recently established field of neuroscience and the law. I have quoted Henry Greely's text to illustrate the language resulting from it.³⁵

If I struggle to understand what it means when humans perceive or think, a reduction of that meaning to observable neuronal signals would intuitively seem to be a promising strategy. So degenerate Cartesianism, situating human perceptual and cognitive capacities in the brain rather than in the mind, should enjoy some appeal amongst all those interested in cutting corners. If my problem is to make Leif walk again, the question of whether his enhanced motoric capacity is bought at the price of Cartesian degeneration might appear secondary to me. So would the question who is walking Leif: Leif himself, his pulse generator, or both.

And, properly considered, a degenerate Cartesian does *not* lose perceptual and cognitive unity with the introduction of neurotechnology. If the mind *is* the brain, a BMI will actually provide for a closer relation between perception and decision. Binoculars equipped with a BMI help a human to focus better on and understand

³² Bennett & Hacker (2007), 20.

³³ Supra, note 21.

³⁴ That stream was sufficiently large to offset a sharp attack on the 'mereological fallacy' of this group of neuroscientist by Bennett and Hacker in 2003, reprinted in Bennett and Hacker (2007). It has led to responses by Dennett and Searle in Bennett, Dennett, Hacker & Searle, *Neuroscience and Philosophy. Brain Mind and Language* (Columbia UP, 2007), 73-96 and 97-126 respectively.

³⁵ It seems that quite a few lawyers entertain a rather instrumentalist interest in neuroscience. One example is the detection of untrue statements in penal trials with neuroscientific methods, suggesting a biological solution to a mental problem.

better what he or she is perceiving as a target, without being distracted by other processes in consciousness competing for attention. So the degenerate Cartesian might hold that neurotechnologically enhanced perception is creating a greater degree of perceptual and cognitive unity.

If the brain's neuronal signals *are* man's perception and cognition, a person linked to a BMI will be fully human, and not a Golem figure. If the brain's neuronal signals *are* man's perception and cognition, neuroweapons *are* compatible with IHL. To be perceived as 'working' in an uncomplicated way, neurotechnology presupposes a reduction to a particular form of biologism. Or, rather, the sequence needs to be reversed: a particular form of biologism enables the functioning of neurotechnology. If one subscribes to it, nothing is lost with the introduction of neuroweapons with IHL software.

What about proper Cartesianism, that does not ascribe the mind's predicates to the brain? Or, for that matter, other ways of conceiving the relationship between mind and body that do not reduce mental processes to biology? Embodied cognitive science has recently experienced a marked upsurge, and it rests on the assumption that the body is not peripheral to cognition. Here is Robert A. Wilson and Lucia Foglia's formulation of the so-called embodiment thesis:

Many features of cognition are embodied in that they are deeply dependent upon characteristics of the physical body of an agent, such that the agent's beyond-the-brain body plays a significant causal role, or a physically constitutive role, in that agent's cognitive processing.³⁶

Here is a stream of cognitive science that should have normative problems with neuroweapons featuring IHL software. If it were the case that IHL was written for individuals whose perception and cognition are embodied in one and the same body, we may not assume that it will yield the same normative outcomes when perception is vested in one human body, and cognition in another.

Having mapped the field of embodied cognition, Wilson and Foglia make out three varieties of the embodiment thesis. The body-as-constraint thesis casts the body as a constraint to the nature and content of representations processed by an agent's cognitive system. The body-as-distributor thesis suggests that an agent's body

36 RA Wilson, & L Foglia, 'Embodied Cognition', *The Stanford Encyclopedia of Philosophy* (Fall 2011 Edition), EN Zalta (ed.), URL = <http://plato.stanford.edu/archives/fall2011/entries/embodied-cognition/> . (last visited 14 November 2013).

functions to distribute computational and representational load between neural and non-neural structures, and the body-as-regulator thesis holds that an agent's body functions to regulate cognitive activity over space and time, ensuring that cognition and action are tightly coordinated. Under any of the three varieties, the use of neuroweapons would imply a normatively consequential reconfiguration of cognition. Why 'normatively consequential'? Historically, IHL norms were articulated for implementation through embodied cognition, and now risk exposure to disembodied forms of cognition. To the extent that the embodiment thesis is more correct in its view of the human than the degenerate Cartesianism that neuroweapons rely on, the operators of neuroweapons are simply unable to apply IHL.

What would it mean if we were to adopt a neuroweapons system incorporating IHL software? So far, I have suggested that any answer will depend on the assumptions one holds on the interaction between mind and body. I have suggested that neuroweapons rely on a biologism particular to degenerate Cartesianism. By pointing to the growing importance of the embodiment thesis, I was able to show that the mind-body problem is indeed a central area of contestation in cognitive science. It would follow that neuroweapons are developed on premises that are reductionist and one-sided, and that the full complexity of cognitive science and biology is not taken into account. Yet I have also suggested that the use of neuroweapons, even if they would feature IHL software, would have normative consequences. Can neuroweapons operators at any level apply IHL? If one merely disavows degenerate forms of Cartesianism, there are moderately strong reasons to reject the ability of neuroweapons operators to apply IHL. This is so because a Cartesian has good reasons to believe that degenerate Cartesianism might bring about normative shifts altering the premises for IHL. If one subscribes, however, to the embodiment thesis in one of the varieties on offer by cognitive scientists, strong reasons support the view that neuroweapons operators are unable to apply IHL.

What remains is the question why the metaphysical premises of neuroweapons so far have eluded a critical scrutiny. When I lecture on neuroscience and weapons development, my audience often displays a significant anxiety about the loss of control over technology. Yet they seem quite prepared to subordinate themselves to what they perceive as its factual groundedness in nature. This reaction is, in itself, a normative one. How is it that neuroweapons, actually developed on the basis of a rather poor metaphysics, nonetheless trigger this submissive reaction with audiences

not uncritical of technology? This question interests me. To pursue it further, I shall focus on language.

E. The loss of language

Let me, then, ask the same question once more: what would be lost if we were to adopt a neuroweapons system incorporating IHL software along the lines I described above?

The use of a neuroweapons system incorporating IHL software would constitute a reduction. The legal *knowledge* of the IHL experts would be reduced to a set of *skills* regarding a particular procedure to be followed in decision-making and a range of *outcomes*. As these skills and this range of outcomes are taken as a baseline for programming, they are uncoupled from processes of verbalisation, discussion with peers and other forms of knowledge production. The complexity of a mind expressing itself through human language, and minds communicating with each other, are reduced to neuronal and synaptic processes, which are scripted in a particular technical language.

In this reduction, human experts provide themselves as raw material for armament production. This is captured well in Martin Heidegger's reflections on what sets modern technology apart from the technology of pre-industrial farming or craftsmanship. In his 1953 text on 'The Question Concerning Technology', Heidegger suggests that it is the river, which is built into the hydroelectric power station, rather than the power station being built into the river.³⁷ He captures this relationship as one of challenging (*Herausforderung*, also translatable into the term 'provocation').³⁸ The decisive difference between a pre-industrial windmill and the power station is that only the latter is designed to store energy, whereas the former is at the mercy of the weather. A power station provokes the river to offer up its energy, to then secure it in a system of storage, which makes it steerable at will. In all this, man is no longer at the mercy of the weather. For Heidegger, these are the main traits of contemporary industrial technology: to challenge or provoke (*herausfordern*) that which nature

37 M Heidegger, 'Die Frage nach der Technik', in *Vorträge und Aufsätze*, 11th ed., Klett-Cotta, (2009) [1954], 9-40 (hereafter Heidegger FT). An English translation by William Lovitt is available as 'The Question Concerning Technology' in M Heidegger, *Philosophical and Political Writings*, (M Stassen ed.), Continuum 2003, 279-303 (hereafter Heidegger QT).

38 Literally, *Herausforderung* is a word composed of the noun 'demand' preceded by the prefix 'out'.

holds, with the purpose to steer (*steuern*) and secure (*sichern*) the energy derived from it at will.³⁹

The same three traits apply to the hypothetical IHL software I described above. Its challenging, steering and securing processes presuppose a group of human beings, not single individuals, as much as it is a running stream of water, rather than single drops of it, that is engaged by a hydroelectric plant. The IHL experts are provoked by combat simulations to impart something that can be stored, steered and secured. The work done to resolve an application problem of IHL in that simulation is transformed into measurements of neuronal and synaptic activities, to then be re-transformed into the code of a computer programme. From there, it is further transformed into a machine-made decision whether or not to attack a material target. As a consequence, humans may be harmed, or not, buildings may be destroyed, or not. Securing the operation of a weapons system through the energy or information imparted by the experts is, however, only an intermediary aspect of this process. In the end, it secures a particular way of waging war, underwritten by a particular form of knowledge production. This knowledge, in turn, is conceived as the ultimate form of knowledge available to humans. It unfolds a particular form of normativity, which affects IHL. I will revert to this in a moment.

In comparing the windmill to the power station, Heidegger sets apart pre-modern technology from modern technology. Yet it is striking how careful he avoids to pass judgement on either form. ‘The Question of Technology’ is antithetic to nostalgia.⁴⁰ Heidegger’s point is to present technology as a mode of revealing truth.⁴¹ From this point onward, he develops the idea that modern technology reveals through *challenging and provoking (Herausfordern)*. The way modern technology relates to truth, we come to understand, is no different from the way it relates to a river, to coal, or to the wind. Modern technology works in two directions. It brings about changes in the material world as much as it produces a particular understanding of what it means to be in the world at all.

39 Heidegger FT, 20.

40 Heidegger ultimately argues that the dangers – material as well as ontological - inhering in contemporary technology actually bring man closer to a ‘saving power’, which he introduces by drawing on Hölderlin’s poem *Patmos. For the Landgrave of Homburg*.

41 ‘Technik ist eine Weise des Entbergens. Die Technik west in dem Bereich, wo Entbergen und Unverborgenheit, wo ἀληθεια, wo Wahrheit geschieht.’ Heidegger FT, 17. In Lovitt’s translation, the passage reads as follows: ‘Technology is a mode of revealing. Technology comes to presence [*west*] in the realm where revealing and unconcealment take place, where aletheia, truth, happens.’ Heidegger QT, 286.

Neither of these changes takes place without the involvement of humans. It is actually decisive for modern technology to address human beings so that they adopt a challenging, or provocative mode of revealing the world.⁴² The essence of technology is, as Heidegger emphasises, nothing technical.⁴³ If we accept this, we may also accept that modern technology made the advent of modern science in the 17th century possible. In this understanding, modern technology as a form of challenging revealing emerged historically prior to the 18th century breakthrough of engineering. The human being is no outsider to this form of revealing. On the contrary, she is assuming a central role, walking the path designated by it, and being challenged by it in a way prior and more original than the coal, the water or the wind.

For more than three centuries, the technological mode of revealing has grown from a rather particular metaphysical choice into ubiquitous technological presence. The advent of neuroweapons is perhaps its most conspicuous example so far, but the way it intervenes into the very process of human perception and cognition differs, in degree, not in kind.

The growth of modern science into an unquestionable and naturalized paradigm accounts for a kind of enchantment. This I felt together with fellow patients when we saw Leif walk unaided. This was sensed by my audiences; anxious about, yet trustful in the metaphysical groundedness of science. In its light or dark form, it remains a dangerous sentiment.

Yet the perception of things as ordered by the apparatus of neuroweapons is not as such more or less natural than any other ordering of perception. It is here that Heidegger takes us further than analytical philosophers criticising degenerate forms of Cartesianism⁴⁴ or cognitive scientists subscribing to the embodiment thesis⁴⁵ would do. He does so, because his account for technology is part of a fundamental critique of *any* form of Cartesianism.

In Heidegger's thought, all entities can be experienced in two different modes. One is presence-at-hand (*Vorhandenheit*), referring to objects present in consciousness, e.g. when we think about them. Another is readiness-at-hand (*Zurhandenheit*), referring to equipment 'that remains concealed from view insofar as it functions effectively'.⁴⁶

42 Heidegger FT, 21.

43 Heidegger FT, 9, Heidegger QT, 279.

44 Bennett & Hacker, *supra* note 28.

45 See Wilson & Foglia, *supra* note 36.

46 G Harman, 'Technology, Objects and Things in Heidegger', *Cambridge Journal of Economics* (2009), 1-9, at 2. Harman argues that a large portion of Heidegger's philosophy 'boils down to the simple opposition between' presence-at-hand and readiness-at-hand (at 3), which he outlines in an accessible and precise manner in his text.

For Heidegger, we relate to the world and the entities in it as “equipment”, and not as subjects encountering objects. When we encounter an entity as equipment, we relate to it as being for a particular task.⁴⁷ When we encounter an entity through the sights of a weapon, we encounter it as being for the task of winning a war (regardless of whether fires are opened on it or not).

Why is this so different from Descartes’ world where a subject encounters an object? The Cartesian way is to make out context-independent objects, to only then add context-dependent meanings to them. These objects are present-at-hand, and at considerable distance from their uses and relations. Heidegger’s preferred encounter with entities is through the mode of readiness-at-hand, in which entities already come laden with contextual meaning. This meaning – the entity’s being itself – can only be partially experienced as an emergent meaning.

Here is the famous Heidegger quote in which he exemplifies the being revealed by readiness-at-hand through the example of a hammer:

The less we just stare at the hammer-thing, and the more we seize hold of it and use it, the more primordial does our relationship to it become, and the more unveiledly is it encountered as that which it is—as equipment. The hammering itself uncovers the specific ‘manipulability’ of the hammer. The kind of Being which equipment possesses—in which it manifests itself in its own right—we call ‘readiness-to-hand’.⁴⁸

As I noted earlier, we relate to anything in the world as equipment, so there is no particular class of things that are equipment in the more traditional sense of tools. Once we keep this in mind, it becomes clear that revelation of what a thing *is* hinges on our preparedness to immerse ourselves into using it, that is, into its readiness-at-hand. Only then can we reveal that which is concealed in them (denoted by Heidegger with the Greek term *lethe*) and let it come forward as truth (*aletheia*, the Greek term for truth or that which is no longer concealed).⁴⁹

What difference does this all make to neuroweapons? I now understand that the neuroscience going into neuroweapons systems is Cartesian in that it isolates neural

47 M Wheeler, ‘Martin Heidegger’, *The Stanford Encyclopedia of Philosophy* (Spring 2013 Edition), EN Zalta (ed.), URL =

<<http://plato.stanford.edu/archives/spr2013/entries/heidegger/>>, section 2.2.2.

48 M Heidegger, *Being and Time*, trans. J Macquarrie & E Robinson, (Basil Blackwell 1962), 98.

49 M Heidegger, ‘Einblick in das, was ist’, in Bremer und Freiburger Vorträge, GA79, 64.

signals in the human brains as completely decontextualised objects. These neural signals are isolated from the fact that they are observed for a particular purpose (in the end, for winning a war). Only *after* making them presence-at-hand as isolated objects, are they endowed with context. It is exactly this Cartesian lack of context that makes them appear as such a solid foundation for any normativity. We risk to believe that this presence-at-hand, this objectivity of the entities is nature itself in purity. So when such neural signals appear, we are prepared, by an unreflected Cartesian habit, to ascribe this appearance a truth value in isolation from the context for which they are used. When a particular neural signal appears in the analysis of a video feed of a theatre of war, we are then *a priori* prepared to ascribe this appearance truth value as to the existence of a target. Here is the normative effect of Cartesianism. With its reduction of reality to a presence-at-hand, it 'sets up one privileged entity as the explanation for all others'.⁵⁰ Neural signals in the human brain are that privileged entity in our case, and the explanation of what is a target flow from it.

With Heidegger's distinction in mind, I may trace how Cartesian ontology effects the hierarchy of academic disciplines as well. To the extent that this ontology posits presence-at-hand as ideal, the sciences will always appear as more normative than other disciplines. Presence-at-hand with its subject-object constellation can be staged much more convincingly in science than in law, social sciences or humanities. Medicine rests on the study of the human body as part of nature, and it is the nature of its natural science that is so well suited as an object maximally distant from all subjectivity. This adds further weight to the normativity I outlined above. I think that the appeal of the law and neuroscience field may be partially explained by the desire of legal researchers to render the most judgemental elements of their discipline more Cartesian.

So neurotechnology in weapons systems adds a particular normativity that is founded on a particular Cartesian ontology. Its workings are very likely to be unconscious to those engaged in the development of these weapons systems and technologies, and, indeed, to many of those criticising them.

I have set out with the question what would be lost with the introduction of neuroweapons, and I have arrived at an answer on what is added, and why it matters. Yet this addition comes at the price of a loss, and it is the loss of language. Why would that loss matter?

⁵⁰ Harman, *supra* note 46, 4, when explaining Heidegger's critique of the history of philosophy as 'ontotheology'.

Why would the reduced role for spoken language affect the implementation of IHL? To the extent that IHL cannot be expressed in the script of computer programmes, it would be doomed to trail the normative primacy of neuroscientific modes of warfare. It is no coincidence that militaries arrange for a standing conversation on IHL between a legal advisor (or judge advocate general) and the commander. Because it is impossible to express the two cardinal principles of distinction and proportionality as a script⁵¹, contemporary IHL is critically dependent on language as a carrier of judgement. The more neuroweapons are used, the less IHL will be applied in a conflict.

There is a second and related argument for the importance of language. Heidegger allots the human a privileged role in revealing things. Presently, this revealing takes place in the challenging mode so characteristic for technology. Yet there is another form of revealing in which language has a privileged role. In his 1950 essay on language (*‘Die Sprache’*)⁵², Heidegger distinguishes between a standard view of language as a medium for humans to express themselves, and his own view, in which language itself speaks (*‘Die Sprache spricht’*).⁵³ Where language does not speak in this particular way, we are left with everyday platitudes or the residuum of information brought about by technology (which may then be broken down into its constituent elements and made computable in a software). Yet when we are attentive to the speaking of language itself, we may hear the peal of silence (*‘das Geläut der Stille’*).⁵⁴ This mode of revealing is not one which challenges, but which lets emerge.⁵⁵ While Heidegger draws on poems to exemplify this revelatory addition to the constituents of language, he makes it clear that this particular type of revelation is necessary for truth to appear. Language and the role of the human in the world are closely related to each other. In combination, they are indispensable for the appearance of truth, if only in a conversation between a legal adviser and a commander.

51 The proper application of the principle of proportionality ultimately rests on an aesthetic judgment. Noll, *supra* note 24.

52 M Heidegger, *‘Die Sprache’*, in *Unterwegs zur Sprache*, GA12, (1959) [1985], 7-30.

53 *Supra* note 17.

54 *‘Die Sprache spricht als das Geläut der Stille.’* (which I would translate into ‘Language speaks as the peal of silence’). *Supra* note 29.

55 In the latter part of his essay on ‘The Question of Technology’ (*supra* note 37), Heidegger marks this mode of revealing with the Greek term *poiesis*. He also points out that the term *techne* in Ancient Greece denoted art, and suggests that it holds ‘saving power’ with regard to the dangers of technological thought. It is tempting to misconstrue him as a romantic, and to overlook the methodological significance of his positions.

Are operators of weapons systems which draw on neuroscience, or their commanders, capable of applying IHL? Only at the price of a decision review system that would be so fundamental as to eradicate the temporal advantages neuroweapons create in the first place. To be meaningful, this review system would need to take the metaphysical foundations of neuroweapons into account.

Why is it unlikely that such a decision review system will be put in place? Because it would undermine trust in the tenability of the metaphysical assumptions that neuroweapons rest on. Neuroscience appears to guarantee that neuroweapons rest on the most objective form of human cognition. This is an enormous normative asset for the defence of such weapons against sceptics. The process of targeting with neuroweapons will be cast as less subjective, less judgemental and less biased than conventional targeting. Very likely, a discourse will unfold that makes the metaphysical choice at the beginning of technological thought disappear. Science will be cast as most immediately related to nature, and neuroscience will be cast as most immediately related to the essence of the human. The normativity derived from these moves will function as contemporary natural law arguments: irrefutable, unless one is prepared to jettison wider belief systems.

With such metaphysics of neuroscience, the disintegration of embodied cognition and its distribution across groups of individuals and machines will be perceived as less problematic, and so will the demise of human language in targeting processes.

Yet the most vexing aspect of neuroweapons is that they render the positions of the operator and her superior so fluid. The human being integrated into neuroweapons is merely a supplier of neurological and synaptic signals, and thus no operator at all. The superior supervising the deployment of a neuroweapon might seem to be its true operator, because it is only in her that an embodied cognition of the battlefield situation is possible. So would this not require the addition of yet another level in decision-taking: that of a true superior, who is able to review the first assessment of the faux superior, who is really only an operator.

Any of these decision-takers is doubly burdened: first, with the assumption that a neuroweapon delivers a description of reality, vouchsafed for by neuroscience as part of the natural science paradigm, and, second, with the awareness that her conscious cognition efforts retard the temporal competitiveness of the system. Both will weigh on her willingness to find against the system.

What takes centre stage in neuroscientific warfare is a radical form of normativity, sourced in firing neuronal networks responding to what is cast and made perceivable as the laws of nature. After the Thirty Years' War, legal thinkers such as Samuel Pufendorf devised a secular natural law with the intention to overcome the tendencies towards annihilation in European religious conflicts. Neuroweapons empirically determine a question that Pufendorf exempted from determination, namely the question of ultimate metaphysical normativity. Therefore, whatever its selling points in terms of increased accuracy and surgicality may be, I fear that a neuroscience of war will prove to be deeply anti-secular. With the depth and sacrosanctity of metaphysical assumptions comes analogous length and intensity of conflict. And, borrowing a term from W.G. Sebald, the violence devised by it will make itself intelligible only as a natural history of destruction.