Published as **Artificial Intelligence and the Sociotechnical Imaginary: On Skynet, Self-Healing Swarms and Slaughterbots. In: Kathrin Maurer, Andreas Immanuel Graae (Eds.): Drone Imaginaries and the Power of Vision. Manchester: Manchester University Press. [forthcoming spring 2020]** Pre-print version.

Artificial intelligence and the socio-technical imaginary: On Skynet, self-healing swarms and Slaughterbots

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> If even senior defense officials with responsibility for autonomous weapons programs fail to understand the core issues, then we cannot expect the general public and their elected representatives to make appropriate decisions.[1]

Slaughterbots, a video that went viral on YouTube shortly after its release in November 2017, may be one of the most influential drone imaginaries to date.[2] Within a few days it had received more than two million views, even though it was not a Hollywood science fiction trailer but a science communication by arms control advocates. In *Black Mirror* style,[3] the video pictures the dangerous potential of the deployment of autonomous swarms of self-flying mini-drones equipped with artificial intelligence (AI) capabilities, cameras, sensors, face recognition and explosives. The video was released by the Future of Life Institute[4] together with AI expert Stuart Russell, a professor of computer science at the University of California, Berkeley. Russell explains at the end of the video that the capabilities of autonomous weapons shown in the film are a very near-future possibility, the

'results of integrating and militarizing technologies that we already have'[5] – and that this development needs to be stopped: 'Allowing machines to choose to kill humans will be devastating

to our security and freedom. We have an opportunity to prevent the future you just saw, but the window to act is closing fast.'[6]

Technoscientific imaginaries

After a decade of academic debate and years of slow-moving negotiations at the United Nations Convention on Certain Conventional Weapons, Stuart Russell and the Future of Life Institute decided to choose a more popular and hopefully effective method of science communication to stimulate critical debate and achieve a ban on lethal autonomous weapons in the long run, because 'serious discourse and academic argument are not enough to get the message through.'[7]

Negotiations over a ban on lethal autonomous weapons have been ongoing at the Convention on Certain Conventional Weapons in Geneva since 2014,[8] with few results. At the same time, many non-governmental organisations (NGOs) and investigative journalist organisations such as the Campaign to Stop Killer Robots,[9] Code Pink,[10] the Bureau of Investigative Journalism[11] and the academic International Committee for Robot Arms Control[12] have been trying to draw attention to massive violations of human rights by drones, with little effect so far. According to Russell's understanding, one of the great obstacles to a realistic debate about the potentials of contemporary AI-based technologies seems to be the traditional socio-technical imaginaries of AI, shaped by films such as the *Terminator* series, *I, Robot* and *Ex Machina*. Thanks in the main to the influence of Hollywood science fiction blockbusters, autonomous AI is often seen as a *conscious* and evil superintelligence working towards the erasure of the human race. This socio-technical imaginary emphasises the power of technology but is implausible in its overstatement of the capabilities of AI. One of the effects of this imaginary has been repetitive discussions of whether AI can gain consciousness or not, while the concrete effects of applied AI, such as the loss of meaningful human control, have often been neglected.

Against this cliché, arms control advocates point out that we do not need to fear that emergent drone swarms will turn into conscious superhuman entities that do us evil. The real problem is that they can easily be turned into weapons of mass destruction (WMDs) – not only by the military or terrorists, but by *any* perpetrator:

> […] We have witnessed high-level defense officials dismissing the risk on the grounds that their 'experts' do not believe that the 'Skynet thing' is likely to happen. Skynet, of course, is

> the fictional command and control system in the *Terminator* movies that turns against humanity. The risk of the 'Skynet thing' occurring is *completely unconnected* to the risk of humans using autonomous weapons as WMDs or to any of the other risks […]. If even senior defense officials with responsibility for autonomous weapons programs fail to understand the core issues, then we cannot expect the general public and their elected representatives to make appropriate decisions.[13]

Obviously, neither politicians, the general public nor defence experts have fully understood the logic, functioning and dangerous potential of contemporary AI-based autonomous weapons systems. Therefore, arms control advocates believe that a new, more realistic imaginary of AI weapon assemblages-in-the-making is greatly needed. They want 'to give people a clear sense of the kinds of technologies and the notion of autonomy involved: This is not "science fiction"; […] and the capabilities are not "decades away" as claimed by some countries at the UN talks in Geneva'.[14]

Given that today many military and university research laboratories are intensively investigating so-called swarm intelligence – in the form of swarming algorithms and micro-robots respectively – researchers fear that the technology projected in *Slaughterbots* will soon be in place. When this happens, the weapons will proliferate very fast and globally, so that the window for a ban on autonomous weapons will be closed – or at least, the ban will become much harder to obtain.

Contemporary research in many high-tech nations is directed towards the development of complex and adaptive swarms of autonomous drones.[15] In October 2017, the US Department of Defence announced 'one of the most significant tests of autonomous systems'[16] when it released a swarm of 103 Perdix drones from three F/A-18 Super Hornet fighter aircraft over China Lake in California: 'The micro-drones demonstrated advanced swarm behaviours such as collective decision-making, adaptive formation flying, and self-healing.'[17] In 2017, Chinese researchers made successful tests with even more (119) micro-drones.[18] China Electronics Technology Group Corporation, a partner in the project, claimed that swarm intelligence was at 'the core of artificial intelligence of unmanned systems and the future of intelligent unmanned systems'.[19]

Images and narratives about drone technology, according to Kathrin Maurer and Andreas Immanuel Graae, are 'a prism of cultural knowledge from which the complex interplay between drone technology and human communities can be investigated'.[20] The concept of the imaginary has been

very well developed in science and technology studies,[21] perhaps most prominently by Sheila Jasanoff and Sang-Hyun Kim. They claim that socio-technical imaginaries are always also imaginaries about our way of life, about collectively shared visions of our social order and desirable futures, which are often seen as something that can be achieved with the help of technological progress. Nevertheless, they are co-produced in the discourses and practices of science, technology and society.[22]

Donna Haraway has pointed out that 'figures and stories […] run riot throughout the domains of technoscience. Not only is no language, including mathematics free of troping; not only is facticity always saturated with metaphoricity; but also, any sustained account of the world is dense with storytelling.'[23] Technoscientific narratives and imaginaries are central to the understanding of our world and its reconfiguration, because stories, imaginations, epistemologies and materialities are intimately linked. We need 'better' imaginaries, metaphors and narratives to change dominant and problematic discourses, to invent 'better worlds'. But what are the imaginaries of AI – in the military, in everyday discourse and pop culture, in the *Slaughterbots* video that went viral? What do they look like? In the following I will give a brief overview of the drone imaginary sketched by the *Slaughterbots* video, the military imaginary of intelligent drone swarms, and the popular culture/Hollywood imaginary of AI, and I will discuss whether the old, Hollywoodesque imaginary is being replaced by a new one.

***Slaughterbots*: The video**

The *Slaughterbots* video pictures the application of drone swarms not in the military but in the civilian realm. It starts with a typical CEO presentation in which the protagonist demonstrates the capabilities of the new technology. The CEO promises that emergent drone swarms, released in hundreds or thousands from an aeroplane, allow an 'airstrike of surgical precision … A 25 million dollar order now buys this … Enough to kill half a city, the bad half', because it 'allows you to separate the good guys from the bad'.[24] The drones are equipped with face recognition software to follow and kill selected targets – according to their social media profiles, for example. With this new weapons system, the CEO claims, 'nuclear is obsolete'.[25] The rest of the video develops two main scenarios in which sitting members of parliament and hundreds of politically engaged students are lethally attacked by drone swarms that have been released by unknown actors.

At the end of the video clip, Russell warns of the problems and effects of autonomous weapons: 'What we were trying to show was the property of autonomous weapons to turn into weapons of mass destruction automatically, because you can launch as many as you want.'[26] The video impressively sketches the potential for mass destruction which becomes possible with autonomous drone swarms. What is not very clear is what kind of 'autonomy' these drones have, how they select their targets and how they get access to relevant data.

The confusion is partly grounded in the fact that autonomy has different meanings in the humanities and in computer science/engineering. From the Enlightenment onwards, autonomy has been related to the free and self-aware subject which chooses its own maxims self-determinedly and consciously – as famously formulated by Immanuel Kant. Even though this concept has been challenged by theorists such as Karl Marx, Sigmund Freud, Michel Foucault and Judith Butler, it still predominates in many realms – for example, ethics, law, economics and also everyday life. At the same time, the concept of autonomy is also central to AI and robotics, but its basic assumptions are very different from traditional humanistic approaches to free will. It goes back to the cybernetic idea of purposeful behaviour in the sense of a pragmatic physiological automated mechanism: think for example of a torpedo with a target-seeking mechanism. Today's control mechanisms in AI systems – for example, in drone swarms – are much more sophisticated than traditional servomechanisms. Nevertheless, these systems still do not follow their own maxims. They are fenced in by norms, values and categories programmed into their software – and although the complexity of software layers might lead to unpredictable effects, these are not intentional.[27]

The *Slaughterbots* drones are autonomous in finding and following their targets, but the profiles of the people to be killed are preprogrammed. It is exactly this sophisticated mixture of autonomous and preprogrammed behaviour that makes it so difficult to understand the challenges posed by this technology.

The military imaginary: Self-healing swarm intelligence

In military discourse, swarm intelligence – the next version of AI – is a big topic.[28] It is regarded as a highly productive feature of self-organising systems which enables them to solve complex tasks on the basis of simple, synchronised behaviour beyond central control. As the systems' entities communicate with each other, they can adapt their behaviour to new situations swiftly. The biomimetic concept is inspired by the behaviour patterns of bird, ant, insect or fish swarms. The

military and the defence sector hope for autonomous swarms (of drones, tanks etc.) with emergent, more flexible and adaptive behaviour which will be capable of solving more complex tasks beyond central control.

William Roper, director of the Strategic Capabilities Office, which is involved in the development of the Perdix micro-drones for the US Department of Defence, writes:

> Due to the complex nature of combat, Perdix are not pre-programmed synchronized individuals, they are a collective organism, sharing one distributed brain for decisionmaking and adapting to each other like swarms in nature […]. Because every Perdix communicates and collaborates with every other Perdix, the swarm has no leader and can gracefully adapt to drones entering or exiting the team.[29]

To date it is not possible to preprogram and operate a swarm of drones: the Perdix drone experiment and other, similar military endeavours are attempts to achieve this, but so far they have been only short-lived attempts with little success. But researchers hope that with the help of decentralised selfcontrol and emergent properties of the autonomous systems, they will be able to adapt faster (know where to move), make faster decisions (know whom to kill) and evolve higher cognitive capabilities (have awareness in the battlespace). With this new quality of autonomy, researchers hope, it will become more difficult to identify (and thereby target/eliminate) the drones. Military defence strategists dream of deploying enormous swarms of drones with different tasks simultaneously, to overpower the enemy by sheer brute force[30]:

> Uninhabited and autonomous systems will enable the next evolution, as forces shift from fighting as a network to fighting as a swarm, with large numbers of highly autonomous uninhabited systems coordinating their actions on the battlefield. This will enable greater mass, coordination, intelligence and speed than would be possible with networks of humaninhabited or even remotely controlled uninhabited systems.[31]

The promises of biomimetic approaches – which try to learn from natural behaviour or use it as inspiration for new design strategies – reach back to the early days of cybernetics, and became dominant in artificial life research and behaviour-based robotics from the 1980s onwards. Even back

then, researchers hoped that complex behaviour might spring from the cooperation of simple entities with simple rules emerging into a more coherent, intelligent whole. With the help of the biomimetic approach, decisive progress could be made, for example, with regard to robots' movement abilities (climbing stairs, dancing, moving smoothly etc.), but the new quality of (cognitive) autonomy was never achieved.[32]

The Hollywood/blockbuster AI imaginary

Many Hollywood or blockbuster science fiction films portray AI as an unpredictable or evil force that develops a superhuman intelligence (HAL in *2001: A Space Odyssey*; Skynet in the *Terminator* series; VIKI in *I, Robot*). AI is often shaped like a human (see *Terminator* or *Ex Machina*); it can develop intentions and strategies like a human, but it has no morality or ethical guidelines. Often it runs amok or tries to take over the world, producing an apocalypse or even wiping the human race from the planet. In these dystopian films, AI is conscious, highly intelligent, dangerous and nontransparent. One might say that these imaginaries are the flipside of imaginaries of the ethical robot (such as in the film *Bicentennial Man*) based on Isaac Asimov's three laws of robotics,[33] ethical AI design principles which prohibit harm to any human being, but which do not play a central role in contemporary popular culture.

The arms control imaginary: WMDs

Stuart Russell and the scientists at the Future of Life Institute strive towards an imaginary of AI beyond that which dominates discourses of the military or popular culture. They do not share the biomimetic military imaginary of autonomous self-healing drone swarms. The military narrative may be different from the Skynet narrative of the evil, conscious, human-like super-intelligence, since it does not run amok, even though it develops its own strategies; nevertheless, it is based on a naturalised, mythological, socio-technical imaginary of AI as an evolving, learning, beehive-like organism that has become intelligent and is capable not only of adapting but also of making strategic decisions – and killing. This dream is pursued in the hope of ultimately making so-called autonomous systems intelligent, and thereby making it possible to 'sustain American military technological dominance'.[34]

What we see in the *Slaughterbots* video is quite different from this US military dream of self-healing, intelligent drone swarms. The swarms of small, fast and cheap drones are deployed by unknown (and hard-to-identify) protagonists to kill political enemies via AI, face recognition/machinic vision and shaped charges. But the target selection is based on preprogrammed criteria applied to the social media profiles of parliamentarians and students. The targeting of individuals on the basis of data analytics is not far from US military insurgency/kill list strategies that are already in place: kill lists (such as the 'disposition matrix') are produced via datamining, by sifting through enormous amounts of data – from drone feeds and military and security service databases to social media profiles.[35] Governments hope thereby to find hidden threats/terrorists, and the collected data is used to select and rank targets for assassination via drone attacks or raids.[36] While non-governmental protagonists may not have access to or be able to hack into military and secret service databases, it is nevertheless possible to build one's own (kill) list of political enemies on the basis of public social media profiles.

The autonomous drone swarms in the *Slaughterbots* video are not staged as self-conscious, intelligent organisms following their own self-determined goals. The slaughterbots are obviously programmed to select their targets via social media data analytics according to pregiven criteria (for example, leftist students engaged in an anti-corruption NGO), and they seek their targets using facial recognition, to kill them with explosives. In following these preprogrammed goals, the slaughterbots may show coordinated, flexible and dynamic behaviour to fulfil their tasks (avoiding obstacles, following humans etc.). But these swarms are neither conscious nor capable of setting their own agendas.

The open question is whether the eminent difference between the imaginary of the selfconscious, intelligent, autonomous AI[37]and the *Slaughterbots* imaginary of tomorrow's AI as a collection of smart software programs is observable. The imaginary of *Slaughterbots* (hopefully) shows that today's or tomorrow's AI makes possible the automation of sophisticated tasks that we would normally expect to be performed by humans. This does not mean that the software programs are intelligent in themselves. Nevertheless, the adaptive, coordinated drone swarms can easily be turned into WMDs.

Matt McFarland of CNN wrote of *Slaughterbots*: 'Perhaps the most nightmarish, dystopian film of 2017 didn't come from Hollywood.'[38] Maybe the arms control advocates' *Slaughterbots* video was an important step towards the development of a new AI imaginary that is not occupied with the old trope of the evil, almighty wrongdoer, but which helps us to debate the 'core issues' of AI, to take responsibility for its development, and to understand the close entwinement of science,

technology and society. Another interesting step in this direction – also not from Hollywood – is the *Black Mirror* TV series episode 'Hated in the nation'.[39] In this episode, a viral Twitter game called the Game of Consequences invites users to choose the hashtag #DeathTo, picking a person to be killed by hacked killer bees. The person who is subject to the most #DeathTo tweets dies the same day. Users are supposedly chosen because of their bad behaviour – from peeing on war monuments to writing clickbait. The killer bees – originally planned as substitutes for natural bees, and now used for government surveillance – kill the victim by penetrating the brain after entering through the nose or eyes. At the end of the episode, all those who have participated in the ranking of victims are killed by drone swarms. The episode is a bitter satire on the enthusiasm for public shaming and the ugly consequences of hate speech and abusive social media usage. Nevertheless, it shows the possibility of turning autonomous drones with profiling technologies and facial recognition into deadly weapons, including in the civil realm.

We certainly need more detailed studies of the multidimensional socio-technical imaginaries of AI and autonomous weapon systems. For now it seems that this is a rather contested field that certainly needs alternative world-making discourses and practices. The imaginary of AI as a decision-making entity is not only part of the Hollywood science fiction narrative, but is also partly implemented in contemporary military discourses that build on biomimetic concepts of emergent and adaptive behaviour, which is the precondition of the idea of swarms as distributed brains that can solve complex problems. At the same time, defence officials deflect urgent questions of arms control, referring to *Slaughterbots* as the product of a Skynet/*Terminator*-style fantasy, while arms control advocates try out new ways of making their point about the growing danger of drones as WMDs. I think we need more interventions to enable new and productive imaginaries which will help us to understand the consequences of lethal autonomous weapon systems.

Notes

1 S. Russell, A. Aguirre, A. Conn and M. Tegmark, 'Why you should fear "slaughterbots": A response', *IEEE Spectrum*, 2018, accessed 28 December 2019, https://spectrum.ieee.org. 2 *Slaughterbots*, directed by S. Sugg, written by M. Wood, *YouTube*, 2017, last accessed 28 December 2019, www.youtube.com.

3 *Black Mirror* is a contemporary dystopian science fiction TV series focusing on possible but unpredicted effects of new technologies.

4 *Future of Life Institute*, last accessed 24 January 2020, https://futureoflife.org.

5 *Slaughterbots*.

6 *Ibid*.

7 Russell *et al.*, 'Why you should fear "slaughterbots"'.

8 *United Nations Geneva*, last accessed 24 January 2020, www.unog.ch.

9 *Campaign to Stop Killer Robots*, last accessed 24 January 2020, www.stopkillerrobots.org.

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12 *International Committee for Robot Arms Control*, last accessed 24 January 2020, www.icrac.net.

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15 M. Rubenstein, A. Cornejo and R. Nagpal, 'Programmable self-assembly in a thousand-robotswarm', *Science*, 345:6198 (2014), 795–9.

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17 *Ibid*.

18 Xinhua, 'China launches record-breaking drone swarm', *Xinhuanet*, 2017, last accessed 28 December 2019, www.xinhuanet.com.

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20 A. I. Graae and K. Maurer (eds), *Drone Imaginaries and* the Power of Vision (Manchester: Manchester University Press, forthcoming 2020).

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23 D. Haraway, *Modest_witness@second_millennium: FemaleMan_meets_oncomouse* (New York: Routledge, 1997), p. 64.

24 *Slaughterbots*.

25 *Ibid*. 26 *Ibid*.

27 L. Suchman and J. Weber, 'Human-machine autonomies', in N. Bhuta, S. Beck, R. Geiss, H.-Y. Liu and C. Kress (eds), *Autonomous Weapon Systems: Law, Ethics, Policy* (Cambridge: Cambridge University Press, 2016), pp. 75–102.

28 J. Arquilla and D. F. Ronfeldt, *Swarming and the Future of Conflict* (Santa Monica: Rand Corporation, 2000), last accessed 28 December 2019, www.rand.org; J. Kosek, 'Ecologies of the empire: On the new uses of the honeybee', *Cultural Anthropology*, 25:4 (2010), 650–78; R. O. Work and S. Brimley, '20YY: Preparing for war in the robotic age', *Center for a New American Security*, 2014, last accessed 28 December 2019, www.cnas.org; P. Scharre, 'Robotics on the battlefield part II: The coming swarm', *Center for a New American Security*, 2014, last accessed 29 December 2019, www.cnas.org.

29 US Department of Defense, 'Department of Defense announces successful micro-drone demonstration'.

30 Scharre, ‘Robotics on the battlefield’; Work and Brimley, ‘20YY’. For a critique, see J. Altmann, ‘Autonomous weapon systems: Dangers and need for an international prohibition’, in C. Benzmüller and H. Stuckenschmidt (eds), *KI 2019: Advances in Artificial Intelligence: 42nd German Conference on AI, Kassel, Germany, September 23–26, 2019: Proceedings* (Cham: Springer 2019), pp. 1–17.

31 Scharre, ‘Robotics on the battlefield’, p. 14.

32 Suchman and Weber, ‘Human-machine autonomies’.

33 I. Asimov, ‘Run around’, *Astounding Science Fiction*, 29:1 (1941), 94–103.

34 Scharre, ‘Robotics on the battlefield’, p. 7.

35 J. Weber, ‘Keep adding: Kill lists, drone warfare and the politics of databases’, in M. de Goede, A. Leander and G. Sullivan (eds), ‘The politics of the list: Law, security, technology’, special issue, *Environment and Planning D: Society and Space*, 34:1 (2016), 107–25.

36 *Ibid*.

37 Whether it be the evil Skynet as a caricature of the ‘rational’, conscious human, or the quasinatural, self-healing drone swarm that emerges towards ‘real’ intelligence.

38 M. McFarland, ‘“Slaughterbots” film shows potential horrors of killer drones’, *CNN Business*, 2017, last accessed 24 January 2020, https://money.cnn.com.

39 *Black Mirror*, ‘Hated in the nation’ (series episode), directed by J. Hawes, written by C. Brooker, *Netflix*, 2016.

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