The epistemology of lethality: bullets, knowledge trajectories, kinetic effects

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The concept of lethality is contested. Bullets may shatter bone, trajectories may well follow predictable paths but the science of killing remains open to debate.[1] When viewed at a macro level, statistical techniques can be applied to draw correlations between factors that lead to death through war. Colonel Trevor Dupuy drew statistical correlations in order to derive measures of combat effectiveness. Designed to offer a degree of certainty for military planners, the goal was to help generals predict how to achieve victory in battle.[2] As this paper will show, however, when considered in micro detail the specific causal mechanisms by which lethality is produced become imprecise to the point that scientific analyses cannot resolve the anomalies. This is more than a macro/micro level of analysis problem. It reflects the epistemological challenge of defining the crossover point between life and death. Given the centrality of violence to martial doctrine, there are a number of reasons why militaries ignore the complexity of lethality and instead emphasise the binary – fight or flight – nature of killing. As this paper will show, much of this is related to processes of legitimating military practice while at the same time sustaining confidence in the strategist's ambition of turning weapon effects into political outcomes.

By reframing the science of killing as a process of legitimating martial practice, this paper analyses the structures of knowledge that sustain the notion of lethality as it is applied in – particularly contemporary American and British – military doctrine. Examining the evolution of the concept, especially as it relates to the production of death by bullet, the multiple and contested meanings of lethality are made transparent. From this it becomes clear how some readings of lethality are suppressed or rendered taboo by the armed forces and their industrial partners who seek to preserve the fiction that science both offers certainty in war and underpins the utility of military operations. The minutiae of terminal ballistics and in particular the application of scientific method for defining lethality can thus be used to analyse the politics and sociology of knowledge as the discourse evolves from the battlefield into the

[1] Rob Kling, "When Gunfire Shatters Bone: Reducing Sociotechnical Systems to Social Relationships," *Science, Technology, and Human Values* 17, no. 3 (1992).
[2] Trevor Dupuy, *Evolution of Weapons and Warfare* (Fairfax, Virginia: Da Capo Press, 1984).

bureaucracy and beyond. This in turn uncovers the social and scientific practices that are used to render normative conceptions of lethality in technical and apolitical terms.

What emerges from this analysis is how the discourse of lethality as both science and as doctrine conjoins in the language of kinetic effects. Kinetic effects is now a dominant phrase in Anglo-American policy and procurement circles, connoting the use of force to strike an enemy so as to achieve a certain battlefield outcome.[3] For the military, a kinetic operation can produce a killing effect and at the same time influence human behaviour. Alternatively, a kinetic operation can be used as a display of force so as to influence behaviour but without producing death.[4] This way of conceptualising military technique continues to shape US strategy under President Trump but it had particular utility for those engaged in counterinsurgencies in Iraq and Afghanistan.[5] However, as this paper will show, the doctrinal edifice that has been built on the language of lethality, where coercion is balanced against winning hearts and minds, rests on a reification of the science of killing that cannot stand up when exposed to close scrutiny.

A detailed investigation into the epistemology of lethality thus presents an opportunity to reveal the intellectual fissures and scientific uncertainties that have been reified and embedded into contemporary conceptions of military power. This not only tells us something about the processes by which science is subordinated to war but also offers a new lens from which to consider how knowledge claims are co-constructed and legitimated through military practices. As a result, this paper recovers a narrative that is otherwise hidden by ontologies of

[3] See for instance, 'Future Kinetic Effects and Weapons Systems Programme' published by the Defence Science and Technology Laboratory, 1 January 2018. Available at: https://www.gov.uk/guidance/future-kinetic-effects-and-weapons-systems-programme. Site accessed 15 November 2018.

[4] See the many references to kinetic, non-kinetic and influencing effects in the British Army's counterinsurgency manual, British Army Field Manual Volume 1 Part 10, Countering Insurgency Army Code 71876 October 2009.

[5] Secretary of Defense Jim Mattis, House Armed Services Committee, written statement for the record. Monday, June 12, 2017. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=8&ved=0ahUKEwiJnp3u15zaAhUrxVQKHfZ3Bu8QFghSMAc&url=http%3A%2F%2Fdocs.house.gov%2Fmeetings%2FAS%2FAS00%2F20170612%2F106090%2FHHRG-115-AS00-Bio-MattisJ-20170612.pdf&usg=AOvVaw2xLwRu_Ov7nI5qzUQYXGZX. Accessed 2 April 2018.

war that emphasise fighting as its central feature, and in the process represents a further analysis of Brighton and Barkawi's argument for a critical war studies.[6]

In order to fully develop this argument, this paper makes four moves. In the first step, drawing on Brighton and Barkawi's seminal paper on critical war studies and the ontology of war, I develop a framework for locating lethality within its scientific and military-technical knowledge regimes.[7] This will create a lens for analysing how lethality is a contested concept. In the second step, I historicise the concept of lethality, explore its knowledge trajectories and show how its meaning stabilised. This will reveal how the notion is rooted in the interstices between the prejudices, professions and technical disciplines of soldiers, surgeons, scientists and engineers. In the third section, I relate lethality to contemporary military doctrine and draw out the contradictions that remain inherent in the discourses of kinetic effect. This is most clearly exposed in relation to counterinsurgency and the military's ambition to apply force judiciously. Finally, in the last section, I analyse the way that lethality is used to legitimate military power and consider how this contributes to our understanding of the ontology of war.

Locating lethality: knowledge regimes, assemblages and the ontologies of war

In their paper, *Powers of War*, Brighton and Barkawi contend that fighting constitutes the ontology of war. Citing Clausewitz, they observe that the uncertainty of the physical struggle comprises the opportunity from which politics and society can be made over.[8] As such, war implies antagonists, an enemy, or some 'other' that must be combatted. Viewed instrumentally fighting is a matter of producing certain effects on an enemy so as to engender political change. Brighton and Barkawi go further than this, however, asking epistemic questions about how fighting refashions subjects and discourses and transforms perspectives in ways that stretch well beyond the strategic calculus to form what they describe as war/truth. In these conditions the battlefield creates the opportunity for unmaking and remaking what might be considered an epistemological given. The uncertainty produced by combat thus occurs at two levels: not only in terms of war's political-strategic logic but also in

[6] T. Barkawi and S. Brighton, "Powers of War: Fighting, Knowledge, and Critique," *International Political Sociology* 5, no. 2 (2011).
[7] K. Grint and S. Woolgar, "Computers, Guns, and Roses - What's Social About Being Shot," *Science Technology & Human Values* 17, no. 3 (1992).
[8] Barkawi & Brighton, (2011).

terms of what constitutes a knowledge claim about fighting and battle and the implications such knowledge claims have for war and society.

Brighton and Barkawi highlight the generative nature of war in order to establish the central concerns of a critical war studies, a field that aims at tracking the disruptive epistemic effects of fighting as it remakes social and political order. As Nordin and Öberg observe, however, this formulation of 'war-as-fighting' also has the effect of reifying ontologies of war such that 'politics, ethics, security or gender risk being forced through the mould of this particular ontology…' irrespective of 'whether this is actually taking place or not'.[9] Instead Nordin and Öberg ask 'what does the idea that war is antagonistic and generative obscure?'[10] Citing the example of target processing they draw attention to the relentless, 24 hour, 365 day a year process of putting 'warheads on foreheads'.[11] This process involves an ongoing cycle that removes the antagonisms of the physical struggle and instead replaces it with staff work and doctrine. The result, they argue, is one where the operationalising of warfare 'is making war in the Clausewitzian sense disappear' even as it re-instantiates itself in television, art, computer games, military recruitment and the arms industry.[12] While these locations might not be central to a philosophy that frames war-as-fighting, they nonetheless still constitute significant sites from which to track war's ontological grounding. The cumulative effect of Brighton and Barkawi and Nordin and Öberg, is, then, to both retrieve fighting from technocratic descriptions of war and to find ways of extending the field of critical war studies into domains that stretch beyond the physical struggle. Curiously, however, despite the fact that science inspired the work of 17th and 18th century strategists like Bülow and Jomini – contemporary strategists with predispositions rivalling and more scientific than those of Clausewitz – neither Brighton and Barkawi nor Nordin and Öberg discuss how scientific analysis says something about the ontology of war.[13]

[9] Astrid Nordin and Dan Öberg, "Targeting the Ontology of War: From Clausewitz to Baudrillard," *Millennium-Journal of International Studies* 43, no. 2 (2015), p. 409.
[10] Nordin and Öberg (2015), pp. 406-407.
[11] A. Bousquet, *The Eye of War - military perception from the telescope to the drone* (Minneapolis: University of Minneapolis Press, 2018), p. 5.
[12] Nordin and Öberg (2015), p. 406.
[13] B. Heuser, *Reading Clausewitz* (London: Pimlico, 2002).

As it stands, then, while critical war studies has explored how the uncertainty of war relates to war's ontology, the field has downplayed the significance of those strategists seeking to reduce the uncertainty of combat by scientifically quantifying battlefield variables. Instead, by restoring fighting as the central feature of war, Brighton and Barkawi follow the Clausewitzian formula that war '…belongs not to the province of arts and sciences, but to the province of social life'.[14] Clausewitzian interpretations dominate contemporary debate on war. It does not follow, however, that scientific knowledge has no bearing for those working in the field of critical war studies. For if fighting constitutes war's ontology then scientific analysis of the battlefield denotes a unique sociological site for tracing the structures of knowledge as it relates to combat. Indeed, when viewed conventionally, the methodological foundation of science offers the means by which an objective yardstick can be developed for defining the reality of battle. According to this line of reasoning, the scientific method itself represents a process by which a disorderly judgement about fighting becomes a socially accepted scientific fact for those administering war.

That is not to say that the scientific method and its approach to the production of facts have escaped the critical eye. On the contrary, social theorists like Woolgar and Latour have developed an anthropology of the laboratory that deconstructed the scientific method along sociological lines. This revealed the socio-technical processes that are inherent in the production of scientific facts and showed how the imposition of various frameworks by scientists was designed to reduce background noise so that they could impose order out of confusion.[15] As Woolgar and Latour demonstrate, the decisions about what background noise ought to be reduced are themselves framed by inter-subjective cultures that are engendered through the craftlike practice of the scientific activity itself.[16]

When applied to critical war studies, Woolgar and Latour's seminal analysis has important ramifications in a discussion of war's ontology. In the first instance, Woolgar and Latour recognise how technology itself is constitutive of science, framing and shaping the scientific

[14] Carl von Clausewitz, *On War*, trans. and ed. Michael Howard and Peter Paret (London: Everyman, 1993), Book 2 Chapter 3, 'Usage still unsettled'
[15] B. Latour and S. Woolgar, *Laboratory Life: the Social Construction of Scientific Facts* (London: Sage Publications, 1979), pp. 36-37.
[16] Latour & Woolgar (1979), p.29.

imaginary. In the second, they create the necessary conditions for applying a variety of methodologies – whether Actor Network Theory or approaches based on assemblages – to an analysis of war, technology and the science of killing.[17] These methods bind the social structures of meaning to the martial technologies under investigation in the same way that technology is constitutive of science.

By opening the lethality black box, then, we can start to see how the technologies of war are a constitutive part of the reification of war-as-killing. More than this, lethality not only constitutes a particular type of knowledge regime that has in some way become subsumed into notions of fighting but also produces end states with ontological consequences. Ontologically speaking, the question of life and death is binary. Humans are either 'alive' or they 'are not alive'. Yet as will become evident, when it comes to questions of lethality, the methodological challenge of defining a crossover point between being and nothingness is scientifically and technically disobedient. Laboratory experiment has been unable to generate the level of certainty necessary to define the optimal process of killing in war. On the battlefield the technological expressions of this uncertainty typically manifest themselves in either 'overkill' or defeat; where overkill is scientifically determined as the over application of lethal force. Consequently, Brighton and Barkawi's argument that 'the chaotic and unpredictable unmaking of certainties' through fighting also has parallels in the scientific realm of lethality.[18] This stems from both the inability to reproduce battlefield conditions in the laboratory and the unique socio-technical challenges that frame the process of trying to model the point at which life becomes death.

In this respect, as Grint and Woolgar argue, functional interpretations of technology do not help generate more certainty in how lethality is defined.[19] To suggest otherwise produces two theoretically loaded observations. Firstly, a functional interpretation implies that weapons produce definable outcomes. Secondly, and flowing from this, a functional interpretation implies that a weapon has some inherent design capacity that is essential to the technology

[17] B. Latour, "On actor-network theory: a few clarifications" *Soziale Welt*, 47 no, 4 (1996), pp. 369-381; G. Deleuze, and F. Guattari, *A Thousand Plateaus* (London: Bloomsbury, 2013).
[18] Barkawi & Brighton, (2011)*, p. 139.*
[19] K. Grint and S. Woolgar, *The Machine at Work: Technology, Work, and Organization* (Cambridge: Polity Press, 1997).

itself. In terms of theory, both of these propositions are problematic as they denote technological determinism and treat technology as an independent variable rather than a constitutive feature of a socio-technical framework.

At an empirical level, however, the challenge of trying to define lethality emerges at the very moment that scientists seek to analyse the phenomenon. While evaluating wound and terminal ballistics provides the hope that ready measurements of battlefield practices might be made, producing scientifically valid conceptions of lethality is made complex in that every single use of a weapon on the battlefield is necessarily unique to the circumstances of its discharge.[20] Given the range of unknown variables that cannot be accounted for, logically its results cannot be reproduced in an open system. A causal explanation of lethality thus requires the creation of a closed environment under laboratory conditions, shooting bullets into blocks of wax or simulant gels. In these instances, the variables can be isolated and mathematical conclusions drawn. Such an approach nevertheless assumes an essentialist reading of a weapon, one where its meanings are defined by its function.

In these circumstances, when thinking about weapons and their effects, an anti-essentialist heuristic shows how lethality gains meaning within a socio-technical framework of relationships. Like Woolgar and Latour's work on the laboratory this makes it possible to analyse the way that a particular interpretation of lethality is reinforced as a social fact for those engaged in ordnance design, development and use. This analysis, in turn, helps us to understand the criteria for developing a scientific explanation of killing in war and provides us with the means for showing how science is institutionalised and legitimated through the military and out into its associated industrial supply chains. As will become clear throughout the rest of this paper, this further demonstrates how countervailing structures of evidence and value judgement overlap and frame the epistemology of lethality.

A short history of lethality

Historicising notions of lethality reveals the many cleavages and contrasting frames for making sense of an increasingly industrial and scientific approach to producing death. The concept of

[20] B. P. Kneubuehl, R. M Coupland, M. A. Rothschild, and M. J. Thali, *Wound Ballistics - Basics and Applications* (Berlin: Springer, 2008), p. 165.

lethality emerges from and is bounded by the state's technical capacity to engage engineers, scientists, soldiers and surgeons. These constituencies bring with them their associated habitus and modes of classification. As notions of lethality move from subjective reasoning to social fact, an analysis of how War/Truth – at least as it might be made sense of through techniques of killing – stabilises and becomes open to further investigation. More than this, by historicising lethality, the very bedrock upon which the martial traditions develop their legitimacy gets thrown into a new light, a process which in itself demands further explanation.

Far from originating in military discourse, the concept of lethality has its roots in the bureaucratised efforts of local officials, engineers and doctors who sought to protect community health and sanitation in the 19th century. As a field of investigation, it brought together a variety of different professions and experts looking to use large-scale data collection methods to interpret and manage morbidity in population groups, what Foucault identified as biopolitics.[21] Working at different ends of the problem, these professions sought to improve the effectiveness of public engineering or make interventions to treat disease. While such efforts might have universal application, a measurement of their success in reducing morbidity could not, however, be assumed. This became much more readily apparent in the 1890s when officials of what would become the World Health Organisation started on the production of an International Classification of Disease. As Geoffrey Bowker and Susan Leigh Star demonstrate, different medical establishments in different parts of the world recorded death in different ways. As a consequence, classification of morbidity could not be readily universalised, because social mores particular to a political community – matters, for example, related to race, gender, marital status, class or colonial status – would typically frame and/or override medical judgement.[22]

The notion that lethality might be a way to think about optimising killing rather than preventing death had not been seriously considered within the military and its associated industrial supply chains even as the First World War took its toll on empires at war. Optimising lethality was not the driving concern of engineers working on armament design. Instead,

[21] M. Foucault, *Society Must Be Defended: Lectures at the Collège De France 1975-76* (New York: Picador, 2002).
[22] G. Bowker and S. Leigh Star, *Sorting Things Out: Classification and Its Consequences* (Cambridge, MA: MIT Press, 1999).

engineering imperatives relating to standardisation, mass production and the commodification of weapon's technology underpinned the ambition of engineers who sought to further refine tolerances in armament design.[23] Of course artillery and ordnance designers had worked on this for centuries.[24] But by the mid-19th century standardised approaches to industrial manufacturing and innovations in ordnance design opened up questions that demanded methodological changes to how lethality was defined. This prompted a number of investigations into the penetrative effects of ammunition from which a rule of thumb definition of lethality emerged. This gauged lethality by how deep a bullet might travel into wood.[25] By the 1880s, this had further iterated into expressions of lethality framed by whether bullets could kill a cavalry horse.[26]

At the turn of the 20th century the meaning of lethality changed once again, this time along racially motivated lines such that modes of killing among European powers was deemed to be methodologically different to those used against colonial insurgents.[27] Prompting the Indian Army to develop the dumdum bullet, this became most obvious during the colonial campaigns on the North West Frontier. The dumdum subsequently became a bone of contention during the Boer War where Britain was chastised by its European rivals for using ammunition designed for 'savage' warfare against colonists of European descent. For the critics, if the dumdum could be used against white Dutch descendants then what would stop military practices from uncivilised colonial wars creeping into warfare between European powers? If

[23] C. Trebilcock, "A Special Relationship - Government, Rearmament, and the Cordite Firms," *Economic History Review* 19(1966); ""Spin-Off" in British Economic History: Armaments and Industry 1760-1914," *Economic History Review* 22 no. 2 (1969); "Legends of the British Armaments Industry 1890-1914: A Revision," *Journal of Contemporary History* 5 (1970); "British Armamanets and European Industrialisation, 1890-1914," *Economic History Review* 26 no. 2 (1973). See also Matthew Ford, Science and Technology (Great Britain and Ireland), in, *1914-1918-online. International Encyclopaedia of the First World War*, ed. by Ute Daniel, Peter Gatrell, Oliver Janz, Heather Jones, Jennifer Keene, Alan Kramer, and Bill Nasson, issued by Freie Universität Berlin, Berlin 2018-04-18. DOI: 10.15463/ie1418.11082.

[24] K. Alder, *Engineering the Revolution: Arms and Enlightenment in France, 1763-1815* (Princeton: Princeton University Press, 1997).

[25] B. P. Kneubuehl et al. (2008). p.92.

[26] M. Ford, "Towards a Revolution in Firepower? Logistics, Lethality, and the Lee-Metford," *War in History*, 20, no. 3 (2013), pp. 273-299.

[27] K. Wagner, "Savage Warfare: violence and the colonial rule of difference in British counterinsurgency", *History Workshop Journal*, 03 January 2018, pp. 1-22.

this possibility was to be prevented, then a more precise definition of lethality would be required, one that might find force in the 1899 Geneva Convention on humane weaponry.[28]

Framed by increased medical engagement with bullet effects,[29] the definition that the armed forces arrived at had to balance what soldiers believed to be militarily expedient with what European powers considered to be internationally acceptable. The concept of lethality thus morphed from the need to knock down cavalry horses towards a definition that emphasised 'stopping power'. This reflected the general distrust of soldiers who concluded that small calibre ammunition produced insufficient power to stop an enemy dead in their tracks. Formally codified by the American small arms designer, Captain Robert Thompson and the military surgeon Major Louis LaGarde the notion that ordnance lethality should be defined by stopping power proved to be enormously persuasive for soldiers.[30] For not only did the concept appear rooted in the experiments and calculations of a credible medical authority but it also resonated deeply with those soldiers who also sought mechanical certainty in the production of battlefield wounding. Even before practitioners and strategists like Clausewitz had observed that 'war is the province of uncertainty', the military had long understood that chaos and complexity was the norm in battle and had sought ways by which to limit its effects through drill and repetitive movement.[31] However, drills and movement were subject to human frailties. By contrast, Thompson and Lagarde offered the technological means by which they could further guarantee the result of battle. When it came to the tactical engagement, then, the best way to achieve a level of certainty that left no room for doubt about the outcome of firing a rifle was to adopt a weapon that would assure the soldier they could stop someone dead.

Intimately connected to the desire of weapon designers to win contracts with the US Army, the Thompson/LaGarde definition of stopping power offered a veneer of scientific authority

[28] S. Keefer, "'Explosive Missals': International Law, Technology, and Security in Nineteenth-Century Disarmament Conferences", *War in History* 21, no. 4 (2014).
[29] J. Gould, "Observations on the Action of the Lee-Metford Bullet on Bone and Soft Tissues in the Human Body" *The British Medical Journal*, 2 (1895), pp. 129-130; H.G. Beyer, "Experiment and Experience with the Rifle." Boston Medical and Surgical Journal" *Boston Medical and Surgical Journal*, 144, no. 1 (1901), pp. 1–10.
[30] C. J. Chivers, *The Gun* (New York: Simon & Schuster, 2011). pp. 233-235.
[31] William McNeil, *Keeping Together in Time: Dance and Drill in Human History*. Cambridge, Ma: Harvard University Press, 1995.

that proved persuasive to those responsible for weapon acquisition. Nevertheless, with the US Army engaged in what became a controversial re-evaluation of its small arms requirements in the 1920s and 1930s, ordnance officials found themselves turning to the US Army's medical establishment to arbitrate between ammunition designs and in the process sharpen up the science of killing.[32] Although senior American commanders who had not been on the front line remained wedded to marksmanship, many officers in the US military concluded that the infantry would need greater firepower if they were to win tactical engagements.[33] The engineering challenge that emerged out of this clash of expectations within the US Army involved the establishment of at least two boards of investigation – colloquially known as the Pig and subsequently the Goat Board – and resulted in ordnance officials abandoning the stopping power criterion in favour of kinetic energy.[34] Specifically, the Americans claimed that 58 ft lbs (80 joules) of kinetic energy was required in order to guarantee death.[35]

Despite the emergence of the kinetic energy criterion, a scientific method had never been formally applied to the problem of lethality prior to the Second World War. Engineers and medics were responsible for defining the technological challenge of producing lethal effect. The result was a mode of thinking rooted in surgery, engineering mechanics and framed by an appreciation for metallurgy. The goal was to develop an absolute criterion that would help ordnance designers and manufacturers by offering specific values from which to design and build equipment. Like life and death, the engineering assumption was that a technology either had the capacity to kill or it did not. In this context scientific investigations into the empirical effects of ordnance on the human body were unnecessary: medics and surgeons could offer an appropriate indicator of lethality without the need to undertake the systematic collection of data from First World War battlefields. Scientific explanations that sought to develop and test different hypotheses about lethality were unnecessary in the circumstances as it was

[32] E. Ezell, *The Great Rifle Controversy: Search for the Ultimate Infantry Weapon from World War 2 through Vietnam and Beyond* (Harrisburg, Pa.: Harrisburg 1984).
[33] R. Gilmore, "'The New Courage': Rifles and Soldier Individualism, 1876-1918," *Military Affairs* 40, no. 3 (1976).
[34] T. McNaugher, *The M-16 Controversies – Military Organisations and Weapons Acquisition* (New York: Praeger, 1984).
[35] See, 'A review of the criteria of wounding power in common use' by Dr B. Deslisle Burns and Dr P.L. Krohn, Ministry of Aircraft Production, Oxford Research Unit, Scientific and Technical Memoranda No.C.3/45, 11 October 1945, p.1, SZ/OEMU/47/19/31, Zuckerman Papers, University of East Anglia.

assumed effective explanations could be deduced from what limited data had already been collected.

With the advent of the Second World War, however, scientists began to challenge the mind-set that assumed lethality was in some way obvious. Central to this effort was the work of the anatomist Solly Zuckerman.[36] Concluding that no data of any real scientific value had been collected during the First World War, Zuckerman initially headed off to the battlefields of Northern France in early 1940. Collecting cadavers, Zuckerman put himself in a position to test existing theories of lethality and in the process help to refashion the discipline along more scientific lines. Although the data he was able to collect was limited by the speed of the German advance across the low countries, Zuckerman had sketched out enough of a research programme that he could go back to the UK and justify further investigations. The opportunity for this came as a result of the Luftwaffe bombing campaign against London in the latter half of 1940.

Eventually culminating in a research paper known as RC350, Zuckerman and his team established that the 58 ft lb kinetic energy criterion might have offered a rule of thumb for engineers but that it did not in fact offer a scientific basis for describing lethality.[37] On the contrary, the British scientists established that the momentum lost by a missile travelling through the body was directly proportional to the degree of tissue destruction. The greater momentum, the greater the tissue destruction. Furthermore, statistical analysis showed that the 400mg weight of ordnance implied by the 58 ft lb criterion was way above the threshold needed to generate death. In fact, projectiles weighing as little as 52mg, or 1/20th of a gram, projectiles that were tiny compared to observations taken from the battlefield, were sufficient to produce hospitalisation.[38] The kinetic energy criterion of 58 ft lbs was not sophisticated enough for Zuckerman et al.

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[36] S. Zuckerman, *From Apes to Warlords: an Autobiography,* (London: Collins, 1988); S. Zuckerman, A.N. Black, and D. Delisle Burns, "An Experimental Study of the Wounding Mechanism of High Velocity Missiles." *British Medical Journal* no. ii (1941).

[37] B. Delisle Burns and S. Zuckerman, 'The Wounding Power of Small Bomb and Shell Fragments', RC350, October 1942, HO 195/13/350, TNA.

[38] This calculation was made possible because two values in the equation for kinetic energy were known. Kinetic energy is defined as half mass multiplied by the square of velocity or $KE = 1/2mv^2$. Rearranging the equation to determine the mass gives results in $m = 2KE/v^2$. Based on the assumption that it took 58 ft lbs to incapacitate and a fragment from a bomb blast struck the target at 2000fps, the mass of a projectile had to be greater than

Instead, what Zuckerman could show was that there was a probabilistic relationship between the ordnance's momentum and the likelihood of hospitalisation. However, if the 58 ft lb, 'all or nothing' criteria lacked precision then the probabilistic calculations that emerged out of the momentum criterion created controversy with American engineers, medics and scientists. On the one hand, a probabilistic calculation implied lethality wasn't a binary affair. On the other, it seemed to offer an explanation as to why some soldiers would keep shooting even after they had been wounded by enemy action. Zuckerman's research into the science of lethality thus implied a rational explanation for how battlefield context, psychology and adrenaline might have an impact on tactical engagements.

The opportunity to scientifically demonstrate how psychology and adrenaline had an impact on combat effectiveness and hospitalisation arrived out of operational research undertaken by Zuckerman following the failed Allied raid on Dieppe in 1942. Previously the conventional understanding of the fight or flight reflexes had been shaped by war in the colonies. Axiomatically, as Charles Callwell demonstrates in his book *Small Wars*, European powers considered these wars to be of a different nature to war in Europe.[39] In medical circles the result was an attitude that emphasised the differences between white and non-white soldiers. Thus Surgeon-Major J.B. Hamilton could write, 'As a rule when a "white man" is wounded he has had enough, and it quite ready to drop out of the ranks and go to the rear; but the savage, like the tiger, is not so impressionable, and will go on fighting even when desperately wounded.'[40] In his analysis of the Dieppe raid, however, Zuckerman effectively took race out of an explanation of fight or flight.

Asked by Lord Mountbatten, the chief of Combined Operations Command, to establish what went wrong during the raid, Zuckerman established that many of the Canadian troops found themselves stuck and unable to clear obstacles or scale the seawall. With their backs to the sea and in the teeth of heavy German fire from deep entrenchments and pillboxes,

0.014oz (i.e. 1/70th of an oz or 400mg). See, Dr B. Delisle Burns and Dr P.L. Krohn, 'A Review of the Criteria of Wounding in Common Use', Ministry of Aircraft Production, Oxford Research Unit, Scientific and Technical Memoranda, 11 October 1945. SZ/OEMU/47/19/31, Zuckerman Papers, UEA, p.4.

[39] C. E. Callwell, *Small Wars: their Principles and Practice* (HMSO: London, 1896, 1899, 1906).

[40] J. B. Hamilton, 'The Evolution of the Dum-Dum Bullet', *British Medical Journal* 14 May 1898, pp. 1250-1250.

Zuckerman's analysis revealed that soldiers fighting in such desperate conditions would carry on using their weapons irrespective of the wounds they had received. Zuckerman later surmised that they did this because they knew they were helping their comrades who were trying to escape.[41] This wasn't a matter of race, gender or training. Rather it was a question of circumstances and the probability that soldiers would be struck by ordnance with sufficient momentum as to produce hospitalisation.

For those American engineers wedded to the absolute criterion of wounding, Zuckerman's research findings appeared to undermine and refashion a whole field of ordnance engineering and design. This was particularly problematic to those in the American Medical Corps and Ordnance Corps who had instilled so much of their reputation and authority into defining lethality as a relationship to kinetic energy. Initiating a series of studies that sought to test the validity of Zuckerman's findings, Colonel George Callender, the commandant of the Army Medical Center arranged for teams of pathologists to collect data from battlefields in Burma, Bougainville and Italy and from the Eighth US Air Force engaging in the strategic bombing of Europe.[42] Callender had hoped he could do more but it was impossible to field a sufficient numbers of pathologists to cover all the fighting fronts and so he was forced to take a more limited approach to data collection in the hope that this analysis would place Zuckerman's own research into statistical context.[43]

Beyond data collection from the battlefield, Callender sought to undermine the momentum criterion by engaging a Princeton zoologist, Professor Edmund Newton Harvey, in primary laboratory analysis. In contrast to Zuckerman, what Newton Harvey and his colleagues observed was that a bullet travelling at high velocity created a permanent and a temporary cavity within a victim. Using ballistic gel as a datum, photographs showed that bullets created a temporary cavity that expanded and contracted several times along the missile's trajectory

[41] See 'Survey of Casualties in Combined Operations against Dieppe carried out on the 19th August 1942', report by Professor Solly Zuckerman to the Chief of Combined Operations. SZ/OEMU/48/5, Zuckerman Papers, UEA.
[42] J.C. Colonel Beyer Jr (ed.), *Wound Ballistics*, Washington, DC: Office of the Surgeon General, Department of the Army, 1962; Preface. Report available at: http://history.amedd.army.mil/booksdocs/wwii/thoracicsurgeryvolII/default.htm. accessed 14 March 2018.
[43] In conversations with British Army Medical Corps personnel, I have been told that it would remain a practical impossibility to undertake the level of pathology required to evaluate the circumstances of death for all those involved in combat at the level of intensity experienced during the Second World War.

before collapsing completely. The bullet also created a permanent cavity which remained even after the missile had passed through the body. Even though at first sight tissue destruction seemed limited to the permanent track, in fact the trauma to the body was considerably more widespread. Unconvinced by Zuckerman's claim that there was a relationship between a projectile's loss of momentum inside the body, the depth of the projectile inside tissue and the need for hospitalisation, Newton Harvey reported that 'Study and measurement of temporary [wound] cavities show that the total volume of the cavity is proportional to the energy delivered by the missile'.[44] Subsequent research came to the conclusion that 58 ft lbs was indeed a fair approximation for the required energy needed to cause the kinds of cavitation that had been identified in the photographs. American scientists could thus reassure the US engineering and ordnance community that the energy criterion provided a rough estimate of the wounding power of small missiles.[45]

Empirically speaking, then, the science of killing evolved such that primarily British and American scientists working at the time of the Second World War produced conflicting analyses of lethality. By the mid-1950s, scientific agreement had still not been reached. That is not to say that decisions about ordnance were put on hold. Indeed, as Erik Prokosch elaborates, the early Cold War witnessed some significant developments in the technologies of death.[46] However, this was not achieved on the basis that the science was in any way settled. British and American engineers still needed to satisfy the requirements of their user communities. Whether these requirements were met in the most optimal manner as defined by a scientific analysis of the alternatives could only be determined in accordance with national perspectives.

Author	Criterion	Year
Benton	Bullet passes through fir plank	1867
Rhone	Kinetic energy 58 ft lb or 80 joules	1896
Zuckerman	$m^{0.4}v$ (bullet passes through)	1942
Sperrazza and Allen	$mv3/2$	1956

[44] Erik Prokosch, *The Technology of Killing: a military and political history of anti-personnel weapons* (London: Zed Books, 1995), p. 20.
[45] See, 'Memorandum for Dr. J.F. Fulton on the Use of 58 ft lbs as a Criterion of Incapacitation', 16 March 1945, SZ/OEMU/44/17/79, Zuckerman Papers, UEA.
[46] Prokosch (1995).

Dziemian	E1–15cms energy transfer in 15cm of gelatine	1960
Sturdivan	Expected Kinetic Energy	1975

Table 1: Summary of Effectiveness Criteria[47]

After the war, with the debate still unresolved one way or another, US definitions of lethality increasingly held sway over the approach taken to ordnance design. This was not a function of any one piece of analysis being more correct than another but rather reflected the pattern of investment into primary research on lethality. With the formation of NATO and the rebuilding of Europe, there was little need for European powers to press their research community into working on questions of lethality. Instead, states were preoccupied with the high politics of nuclear weapons and deterrence. Consequently, the debates between 1955 and 1979 tended to be controlled by the US, the one power that continued to invest in primary research into lethality. The only concession that the United States was prepared to make to Solly Zuckerman and the British analysis from the Second World War was to recognise the importance of velocity for delivering increased kinetic effect. This in turn led to evolution of the Small Calibre, High Velocity bullet concept that underpinned the ammunition for the M16 rifle.

Unable to reach some form of agreement on processes of lethality, scientific communities in Britain and the US could continue to develop explanations according to their own principles. The mechanisms that might have helped facilitate the stabilisation of a theory of lethality could not be defined. Instead the result was a multiplicity of interpretations. This only changed as the British withdrew from undertaking primary scientific research into lethality, thus conceding the field to their American partners. This in turn conceded the definition of lethality to American researchers and a community of non-scientists who had an interest in sustaining the kinetic energy criterion and in effect legitimated existing ordnance design and production practices. Indeed, while other theories have come and gone (see Table 1), what has emerged out of the various investigations into the science of killing is a multiplicity of approaches that reinforce pre-existing design choices about ordnance.

[47] Kneubuehl et al. (2008), p. 185.

As this short history of lethality demonstrates, there have been multiple and contested interpretations of how bullets shatter bone. This has not produced a Newtonian or Einsteinian revolution in the way militaries define lethality. Rather, there has been a symbiotic relationship between those technicians working on evolutions of weapon technology and the way that they have sought to convince military officials to adopt and procure their inventions. These webs of relations have typically been framed along lines of nationality, theories of race and the prejudices of soldiers and engineers. By retelling its history, we can see that there is no pure science of lethality; only a science that is framed by the exigencies of military strategy and the demands of the state as enabled by engineers. Out of this process the language of kinetic effect – as opposed to the language of momentum effect – has been cemented into the lexicon of those military-technical officials who were working on how to deliver combat effectiveness on the battlefield.

Overkill, counterinsurgency, military doctrine

In terms of the contemporary international norms of war, it is taken as axiomatic that there is a legal distinction between killing in war and killing in peace. When at war, society consents to the taking of life as morally, socially and legally acceptable. If soldiers kill without the authority afforded by the state, then they break the law. Given these constraints, it is no surprise that the training, psychology and doctrine that sustains a soldier's ability to kill is a source of significant discussion.[48]

As Tony King argues, however, matters relating to training and psychology can also be reframed as indicators of the growing professionalisation of the armed forces; a professionalisation that is expressed through an increasingly sophisticated use of Tactics, Techniques and Procedures (TTP) now exploited by the infantry in Close Quarter Battle.[49] These TTPs demand the highly controlled use of force in order to deliver precise tactical effect. As such, soldier professionalism is expressed in terms of avoiding overkill through the careful

[48] See for instance J. Bourke, *An Intimate History of Killing: Face-to-Face Killing in Twentieth-Century Warfare* (London: Granta, 1999), p. 239; and D. Grossman, *On Killing: the Psychological Cost of Learning to Kill in War and Society,* (Boston: Little, Brown and Company, 1996).

[49] A. King, *The Combat Soldier: Infantry Tactics and Cohesion in the Twentieth and Twenty-First Centuries*, (Oxford: Oxford University Press, 2013).

application of technique and the avoidance of inefficient, unnecessary or inadvertent use of violence.

What has not been subject to any rigorous analysis, however, is how the science of lethality has been operationalised to reinforce and legitimate martial practices as understood through doctrine. As this section shows, the military legitimacy of these practices is based on a series of contested understandings of lethality which themselves only become readily apparent when thinking through the language of kinetic effects as applied in the realms of counterinsurgency (COIN). By creating a space for questioning the science of killing in COIN, it becomes possible to show how the binary conditions that frame an analysis of lethality in conventional war also break down. This then exposes the military to more fundamental questions about the instrumentality of war, the value of military life and the effort that armed forces make to maintain the notion that war has utility.

When it comes to counterinsurgency and 'wars among the people' the initial impulse of the armed forces is to try to control the theatre of war.[50] In part this is managed by controlling the reproduction of ordnance's brutal effects in the media in order to shape popular responses to acts of violence. In practical terms this means minimising obvious bloodshed and 'eliminating the visage of death from television'.[51] During the first Gulf War, managing the media involved embedding journalists into military structures in an effort to make it easier to direct the way that reporters visited the battlefield. By extension this gave military planners a mechanism for shaping what appeared on CNN and the evening news.[52]

Framing the way reporters work in an effort to influence the strategic narrative is not the only way that armed forces have sought to control the theatre of war. On the contrary, armed forces have long understood that they also need to control technology and warfighting doctrine so that they produce violent effects in specific ways.[53] Precision-guided munitions, for example, offer the intoxicating possibility of a clean war. But notions of a clean war can

[50] Rupert Smith, *The Utility of Force* (London: Penguin Books, 2006).
[51] R. Stahl, *Militainment, Inc. - War, Media, and Popular Culture* (New York: Routledge, 2010).
[52] W. Merrin, *Digital War - a critical introduction*, (London: Routledge. 2018).
[53] A good summary of the RMA and delivering just-in-time military effects can be found in D. Lonsdale, *The Nature of War in the Information Age: Clausewitzian Future*, (London: Frank Cass, 2003).

even be found in the way that armed forces have regularly sought to reduce the blood and gore that is produced from low-technology ordnance like small arms ammunition. These efforts have the benefit of reducing shock for soldiers while limiting the negative media connotations that might emerge from accusations of pursuing a policy of 'overkill'. Thus, for example, in the 1970s during the IRA insurgency, the British Army was very keen to find a bullet that had 'the same accuracy as afforded by the current rifle but which does not penetrate nor make a wound of dreadful appearance'.[54] In seeking a technical fix, the Army recognised that both their existing service ammunition and their soldiers' inability to shoot accurately had the potential to unhinge a strategic narrative that was otherwise framed in terms of supporting the police in their endeavours to protect civil society.[55]

Consequently, in the context of counterinsurgency, applying force judiciously and in ways that create definable military effects has been particularly important. In these circumstances, although they might otherwise be engaged in what some might describe as a police action,[56] militaries are very keenly aware that if they are to retain their own chain of command and avoid excessive civilian oversight then they must carefully balance the way lethality is represented. Gung ho expressions of military masculinity are reframed in terms of professional TTPs and calibrated applications of violence so as to justify the way that force is employed.

With the advent of web 2.0 technologies, however, professional TTPs as they are applied to COIN can only go so far. Put simply, technological overkill produces dramatic results that are readily amplified online, irrespective of whether armed force is employed in conventional or irregular operations. The explosion of digital imagery through social media, whether it has been produced by soldier body-cams or citizen journalists, places even more emphasis on adopting weapons that limit bloodshed. Failure to take this into consideration plays into the hands of those who use digital media and military spectacle to manage how the battlefield is

[54] Paper by CDI(A) on Future Tactical Doctrine and Equipment Requirements for Operations in Support of Civil Power, 31 July 1970 – Use of Troops in Aid of the Civil Power – Setting up of a Working Party on Internal Security Tactical Doctrine, HO 325/132, UK National Archives.
[55] John MacKinlay, "'Shoot to Kill' - An Assessment", *British Army Review* no. 48 (1974), pp. 45-49.
[56] James Salt and M. L. R. Smith, "Reconciling Policing and Military Objectives: Can Clausewitzian Theory Assist the Police Use of Force in the United Kingdom?" *Democracy and Security*, 4 no.3 (2008), pp. 221-244.

represented among civilian audiences; audiences who otherwise might be persuaded to join or withdraw from getting involved in combat.[57]

Nevertheless, sustaining military legitimacy through media manipulation is but one side of the challenge of contemporary war. The other and arguably more difficult question facing military planners concerns the way that doctrine and technology are standardised so as to further control the precise delivery of military effects. Post-Iraq and Afghanistan these concerns find their most mediatised expression in the form of drone warfare, technologies that shape the martial gaze while enabling greater precision in the use of airpower.[58] In terms of doctrine, in the early 2000s, the Americans framed their application of these technologies through the lens of an Effects Based Approach to Operations (EBO). According to EBO, planners would define the kinetic and non-kinetic – sometimes described as influencing – effects that they wanted to achieve and work backwards to precisely apply a range of military capabilities to deliver that outcome.[59]

Although EBO was eventually rejected by General Mattis in 2008, the notion that the armed forces were interested in creating 'effects' continued to find its way into military discourse especially as it related to COIN doctrine and operations in the human domain.[60] The British Army's Countering Insurgency Field Manual, for example notes that, 'Often, the most effective activities are in the psychological domain and are designed to persuade and influence target audiences using non-kinetic means' but that 'If physical destruction is required to achieve the desired effect, then the commander must consider and balance the potential negative impact it may cause against the expected benefits'.[61] By the time American and British armed forces

[57] T. Rid and M. Hecker, *War 2.0: Irregular Warfare in the Information Age*, (Westport, CT: Praeger. 2009).
[58] Bousquet, A. "A Revolution in Military Affairs?: changing technology and changing practices of warfare". In *Technology and World Politics*, edited by D. McCarthy (Abingdon: Routledge, 2018), pp. 165-181; and Bousquet, *(2019)*.
[59] For a discussion of the Effects Based Approach see, Tomislav Z. Ruby, "Effects-based Operations: More Important Than Ever", *Parameters*, Autumn 2008, pp. 26-35.
[60] Tomislav, 2008; for effects, COIN doctrine and the human domain see also *US Special Forces Command, Operating in the Human Domain*, version 1.0, 3 August 2015. This version is available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwiqiamdmenhAhW2ZhUIHYsjBPoQFjAAegQIAxAC&url=https%3A%2F%2Fnsiteam.com%2Fsocial%2Fwp-content%2Fuploads%2F2017%2F01%2FSOF-OHD-Concept-V1.0-3-Aug-15.pdf&usg=AOvVaw0fnEQKjKyzJDRX9_M2qBxz. Accessed 24 April 2019.
[61] British Army Field Manual Volume 1 Part 10, Countering Insurgency Army Code 71876 October 2009, p. 7-4 and p. 6-7.

had properly updated their COIN manuals to more effectively engage in the Global War on Terror the language of kinetics as a way of producing a clinical lethal or societal effect had become widely accepted.

Following the end of counterinsurgency missions in Iraq and Afghanistan, the question of lethal and non-lethal effects is now firmly embedded in US military doctrine for all types of operation, whether conventional or irregular. Thus, in the 2018 version of the US armed forces capstone doctrine publication known as *Joint Publication 3-0, Joint Operations* it is taken for granted that today's threats can 'increasingly synchronise, integrate, and direct operations and other elements of power to create lethal and nonlethal effects'.[62] The challenge for American forces will be to evaluate the outcomes of these lethal and nonlethal effects through battle damage assessment; assessment that is designed to demonstrate the feedback loops between the application of force and the consequence of that activity.[63]

Using technology to buttress the utility of doctrine in war is, however, sharply exposed as a purely rhetorical fix when set against the way that lethality criteria apply in domestic law. To be sure, different jurisdictions have viewed lethality differently over time. What was legally acceptable in a colonial context far exceeds what was legally acceptable in metropolitan Europe. Even today, hollow point ammunition – ammunition that has similar effects to dumdum bullets – is not subject to the Geneva Conventions when used domestically by lawfully authorised institutions such as the police. At the same time, in an effort to control the public's access to firearms, countries like Britain have sought to carefully define lethality and re-write the legal definition of a firearm in increasingly restrictive ways. Thus, as far as Britain's Crown Prosecution Service (CPS) is concerned, a firearm is a 'lethal barrelled weapon of any description from which any shot, bullet or other missile can be discharged'. Even more critically from our point of view, the CPS goes on to state that while the notion of lethality is complex and subject to the decision of a court of law on advice of the Forensic Science

[62] Joint Publication 3-0, *Joint Operations*, 17 January 2017 – Incorporating Change 1, 22 October 2018, p. I - 3. Doctrine note available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwi9vtCN6d7hAhUDPVAKHUw7B48QFjAAegQIARAC&url=https%3A%2F%2Fwww.jcs.mil%2FPortals%2F36%2FDocuments%2FDoctrine%2Fpubs%2Fjp3_0ch1.pdf%3Fver%3D2018-11-27-160457-910&usg=AOvVaw04JZDavDBIt1UIInEP4elH. Accessed 20 April 2019.

[63] Joint Publication 3-0, p. II - 11.

Provider, air weapons with a kinetic energy at the muzzle of greater than 6 ft lbs are 'specially dangerous'.[64]

The contrast between the 6 ft lbs and the 58 ft lbs lethality criterion is clearly framed by the constraints and perspectives of different legal and military technical communities. The British approach to firearms control reveals a discrepancy in how the state defines lethality when overseas in a war compared to at home within civil society. So long as these two conditions can be kept separate then the inconsistency need not be problematic. Unfortunately, however, when the military are employed in policing actions in support of a counterinsurgency it becomes readily apparent that lethality has contextually dependent meanings that reflect expediency and political choice. In a COIN operation, should the military definition of lethality apply or the domestic definition?

In the mid-1990s the effort to reconcile these different definitions of lethality found some resolution in the concept of 'less than lethal' weapons: weapons with a kinetic energy criterion of less than 58 ft lbs.[65] During the interventions in Iraq and Afghanistan, however, the niceties of this technological fix were exposed for the rhetorical contradictions that they contained. Less than lethal weapons could be just as dangerous when used inappropriately as their conventional equivalents. Moreover, the failure to apply domestic policing criteria during these operations meant that intervening powers would not make use of forensic techniques for gathering evidence about a soldier who had discharged their weapon and where civilians had been injured or killed. That this did not happen betrayed the cultural predispositions of those powers engaged in civilising unruly parts of the world through military intervention.[66]

The practical implications of these different definitions of lethality thus manifest themselves in paradoxical ways when the context changes from domestic policing to military intervention followed by maintaining law and order overseas. What is revealed is the unscientific and

[64] 'Firearms - Legal Guidance' from the Crown Prosecution Service. Available at: https://www.cps.gov.uk/legal-guidance/firearms. Site accessed 28 March 2018.
[65] B. Rappert, *Non-Lethal Weapons as Legitimizing Forces?: Technology, Politics and the Management of Conflict* (London: Frank Cass, 2003).
[66] Mark Neocleous, "The Police of Civilization: The War on Terror as Civilizing Offensive", *International Political Sociology*, 5, no 2, 2011.

contextually specific nature of the military's approach to lethality. During wars in Iraq and Afghanistan, as repeated cases of military abuse surfaced, service personnel and military contractors struggled to determine whether their activities ought to be framed in terms of domestic law or whether some other legal framework applied.[67] If domestic law pertained and lethality was defined in non-military terms then the potential was that whole realms of military activity would become illegal.

When military power is applied in contexts other than conventional warfare, it becomes easier to see how technology and doctrine sloganise kinetic effects in ways that sustain the utility of force and subordinate science to war. Domestic definitions of lethality betray the contested nature of the kinetic energy criterion and imply that the amount of kinetic energy needed to produce death is framed by military rather than scientific considerations. An examination of military doctrine demonstrates how kinetic effect is further reified so as to preserve the legitimacy of military power beyond irregular and into broader, more conventional operations. These reifications are in turn sustained through martial, legal and technological practices so as to frame an argument that buttresses claims about the instrumental utility of military power. This resonates with what Nisha Shah describes as an ontology of lethality that 'delimits the arsenal of acceptable weaponry' and opens up the discussion as to why the armed forces privilege interpretations of lethality that support their technological choices.[68] This then points us towards exploring the politics and preferences of those engaged in framing the technologies and techniques of martial practice.

Legitimation, military power and the military's lethality taboo

Given the examination so far, it is clear that the science of killing has produced a number of ways of making sense of the term lethality. These interpretations have been marshalled and then reified in doctrine and technology. The argument made here now turns to the way that questioning this ordering of lethality has been rendered taboo by the armed forces themselves as they seek to restrict discussion that undermines the efficacy of the military use of force; a

[67] H. Bennett, "The Baha Mousa Tragedy: British Army Detention and Interrogation from Iraq to Afghanistan", *British Journal of Politics and International Relations*, 16, no 2, 2014; E. Klein, "Immunity in Counterinsurgency Operations: A Proposal for US Contractors", *Parameters*, 47, no 1 2017.

[68] N. Shah, "Gunning for war: infantry rifles and the calibration of lethal force", *Critical Studies on Security* 5, no. 1, (2017), p. 99.

discussion that if properly examined would by implication have the potential to delegitimise military activity. Far from being arbitrary, then, avoiding discussion of lethality reflects the politics and preferences of those engaged in 'contemporary sovereignty-as-decision-making'.[69] This is not just the instrumentalisation of knowledge for the purposes of securing life/death. Rather the science and its supporting mechanisms legitimate the interests of the various associated social groups engaged in these activities, working in such a way as to ensure certain martial practices can continue without cross-examination.

The question of lethality – as it has been cashed out in terms of kinetic energy – thus constitutes a foundational knowledge regime upon which the structures of military power have become staked. Investigations into the nature of lethality help to expose the military's social order and its relationships to science, technology and the wider industrial and social processes that constitute various types of militarism.[70] The kinetic energy criterion is how the military define what comprises an effective munition for causing death. As we have seen, however, civilian definitions of lethality also have a bearing on how death is produced. It is evident, then, that as a mode of delivering military effects, lethality has a unique power that serves as a socio-technical metaphor, determining whose life is valued and how death is distributed on the battlefield. In this respect, the fact that military definitions of lethality apply in irregular civil-military contexts like counterinsurgency shows how socio-technical choices privilege the value of an intervening force over those of the civilians that are to be won over.[71]

The act of opening up the technological black box and investigating the question of lethality offers a further explanation for why the armed forces have chosen not to question the kinetic energy criterion too closely. To do so reveals that military life is valued over and above that of an adversary or a civilian. Left unstated, this in turn creates space for a lethality taboo such that the taboo and its transgression are placed in 'a paradoxical relationship in which each causes the other'.[72] To question the 58 ft/lb criterion is therefore self-defeating, undermining the efficacy of armed force in ways that delegitimise military activity but also the activity of

[69] M. Shapiro, *Discourse, Culture, Violence* (Oxford: Routledge, 2012), p. 189.
[70] Mabee, Brian, and Srdjan Vucetic, "Varieties of Militarism: towards a typology", *Security Dialogue* 49 no: 1-2 (2018), pp. 96-108.
[71] Ken MacLeish, "The ethnography of good machines", *Critical Military Studies* 1 no. 1 (2015), pp.11-22.
[72] Ian Whitmarsh, "The No/Name of the Institution", *Anthropological Quarterly* 87, no. 3 (2014), pp. 881.

scientists, ordnance manufacturers and all of those involved in the wider social structures of militarism. The science of killing accordingly enables military power to be expressed through technology but the military itself cannot afford for the various conceptions of lethality to be closely questioned for fear that it would undermine the utility of force.

This examination into the epistemology of lethality thus reveals that uncertainty isn't simply constrained to what Clausewitz might describe as luck or chance but also stretches right up to the limits of what is both scientifically knowable and militarily acceptable to investigate. Further, it demonstrates that the social mechanisms put in place to make sense of what is otherwise unknowable are designed in such a way as to perpetuate a mode of thinking about war that enshrines a particular ontological outlook. That ontological outlook reinforces the utility calculations that underpin our conceptual understanding of strategy and war. What this outlook does not do is take into consideration the problem of defining the ontology of war given the unstable definition of lethality.

In this respect, at the centre of this epistemology of lethality there is an expanding symmetry of explanation such that the social processes that enframe and explain micro-level causal chains mimic the macro-level goal of the strategist trying to control campaign narratives. As a feminist and gender-based analysis demonstrates, this can be seen in the way that combat is constructed as a normative category that enables military masculinities to make sense of and discipline battle.[73] According to this line of argument the empirical foundations upon which notions of combat are framed privilege forms of gender and power relations so as to essentialise the space as predominantly male. Similarly, modes of constructing lethality reify the utility of force in ways that try to make the battlefield predictable in an effort to stabilise martial control of combat.

The object of this science is, then, to measure and make sense of what is otherwise opaque and riven with anecdote and at the same time to help impose order on the uncertain. Finding ways to (mis-)represent war has always been an object of those who are engaged in prosecuting it. By applying a frame of reference drawn from Science and Technology Studies,

[73] Katharine M. Millar and Joanna Tidy, "Combat as a moving target: masculinities, the heroic soldier myth, and normative martial violence", *Critical Military Studies* 3 no. 2 (2017), pp. 142-160.

however, the strategic goal of controlling narratives nonetheless takes on new resonance. As Barkawi and Brighton observe, power shapes war/truth in terms that characterise and legitimate political violence for those societies engaged in war. This applies equally to those actors engaged in framing the way violence is optimised through definitions of lethality. In both cases uncertainty can be tracked back to an inability to trace a causal chain of events from the strategic to the tactical level. This isn't just a limitation of the scientific method but more deeply speaks to whether an ontology of war can be rendered transparent.[74]

Investigations into the epistemology of lethality thus reveal something that is missing from literatures on critical war studies. Brighton argues that war 'forces the unmaking and remaking of social and political meaning in ways that defy prediction'.[75] The attempt by armed forces to impose order through science – irrespective of the precision of the analysis – is nevertheless an attempt to make war predictable. The accuracy of these predictions may well prove to be uncertain. It remains the case, however, that the armed forces themselves have sought to tame the unknowable battlefield through technology even as fighting has sought to unmake the truths produced from war. In this respect, the epistemology of lethality reveals the countervailing and multiple truths that co-exist and must be controlled if military instrumentality is to be sustained.

Conclusion

As this paper has demonstrated, the science of killing is a complex field of study. Whereas many scholars have previously suggested that lethality is a relatively uncontested field,[76] by historicising the concept we can see that there is no simple formula for explaining how ordnance produces death. On the contrary, this paper shows that the field is contested and disobedient and continues to produce multiple interpretations of the processes by which bullets shatter bone. By taking an anti-essentialist approach to the study of technology it becomes easier to reveal the various trajectories of knowledge and the means by which the several interpretations of lethality begin to stabilise and turn into social fact. Consequently,

[74] Marc von Boemcken, "Unknowing the unknowable. From 'critical war studies' to a critique of war", *Critical Military Studies* 2 no.3 (2016), pp. 226-241.
[75] Brighton, "Three propositions on the phenomenology of war", *International Political Sociology* 5, no. 1 (2011), p. 103.
[76] J. Bourke, *Wounding the world: how military violence and war-play invades our lives*, (London: Virago, 2014)

we see how the subject of lethality fits into the interstices of several overlapping social frameworks and as a result is caught between the concerns of soldiers and engineers, scientists and surgeons. Oscillating between these constituencies, the various definitions of lethality say something about the relative power of those actors who have a role in shaping the way that the battlefield is both enacted but also understood.

This is made abundantly clear when military versus civilian characterisations of lethality are set side by side. If the 58 ft lbs criterion of lethality is considered overkill by civilian courts the question arises as to why this nominal figure might continue to frame weapon selection in counterinsurgencies or interventions where population control is more important than killing. Not only does this point to the double standards that apply when seeking to manage overseas interventions but it also reveals the extent to which the military cannot concede ground to those who might question the lethality criterion. According to this rubric, a military definition of lethality must be sustained or else policing activities as part of a military intervention would become unsustainable. Indeed, to concede the point about lethality would also be to accede to a level of civilian oversight that would have demanded a degree of forensic policing that the armed forces had previously eschewed. At its root then, sustaining the military's independence of action has meant holding on to a military definition of lethality.

The advantage of applying a military definition of lethality over and above that of a civilian court is not just in the independence of action that such an approach affords. The dual role of lethality also lies in the way that it underlies and further orders the existing relationships of power within and between different military constituencies and their scientific and industrial partners. In this respect, lethality not only sustains the idea that military power has utility, that is to say that instrumental applications of state violence can be used to create pre-determined political effects, but it is also used to perpetuate the world views of those strategists, generals and policy makers who have a vested interest in retaining their position in the state. Thus, the different definitions of lethality have themselves been disciplined by and subordinated through the technologies and institutions that powerfully shape and perpetuate those meanings.

The significance of this paper, however, lies in exposing the underlying reifications that frame the concept of lethality and showing that even weapon effects can be deconstructed in ways that reveal the politics of making truth from war. Weapon effects themselves represent a form of knowledge about the battlefield. This knowledge requires social and scientific buttressing in order to sustain the edifice of those engaged in these military practices. As such, deconstructing lethality reveals the interlocking matrices of social values and concerns that shape the creation and use of military power. By exploring the limits of knowledge as it relates to developing a scientific explanation of lethality we can start to offer a further yardstick for how war/truth is constructed by the military itself. In the process, this paper points to the way that science and technology constitute an important location for studying ontologies of war.