AI Can Stop Mass Shootings, and More

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Abstract

We propose to build directly upon our longstanding, prior r&d in AI/machine ethics in order to attempt to make real the bluesky idea of AI that can thwart mass shootings, by bringing to bear its ethical reasoning. The r&d in question is overtly and avowedly logicist in form, and since we are hardly the only ones who have established a firm foundation in the attempt to imbue AI's with their own ethical sensibility, the pursuit of our proposal by those in different methodological camps should, we believe, be considered as well. We seek herein to make our vision at least somewhat concrete by anchoring our exposition to two simulations, one in which the AI saves the lives of innocents by locking out a malevolent human's gun, and a second in which this malevolent agent is allowed by the AI to be neutralized by law enforcement. Along the way, some objections are anticipated, and rebutted.

Introduction

No one reading this sentence is unaware of tragic mass shootings in the past. Can future carnage of this kind be forestalled? If so, how? Many politicians of all stripes confidently answer the first question in the affirmative, but unfortunately then a cacophony of competing answers to the second quickly ensues. We too are optimistic about tomorrow, but the rationale we offer for our sanguinity has nothing to do with debates about background checks and banning particular high-powered weapons or magazines, nor with a hope that the evil and/or insane in our species can somehow be put in a kind of perpetual non-kinetic quarantine, separated from firearms. While we hope that such measures, which of late have thankfully been gaining some traction, will be put in place, our optimism is instead rooted in AI; specifically, in ethically correct AI; and even more specifically still: our hope is in ethically correct AI that guards guns. Unless AI is harnessed in the manner we recommend, it seems inevitable that politicians (at least in the U.S.) will continue to battle each other, and it does not strike us as irrational to hold that even if some legislation emerges from their debates, which of late seems more likely, it will not prevent what can also be seen as a source of the problem in many cases: namely, that guns themselves have no ethical compass.

What Could Have Been

A rather depressing fact about the human condition is that any number of real-life tragedies in the past could be cited in order to make our point regarding what could have been instead; that is, there have been many avoidable mass shootings, in which a human deploys one or more guns that are neither intelligent nor ethically correct, and innocents die or are maimed. Without loss of generality, we ask the reader to recall the recent El Paso shooting in Texas. If the kind of AI we seek had been in place, history would have been very different in this case. To grasp this, let's turn back the clock. The shooter is driving to Walmart, an assault rifle, and a massive amount of ammunition, in his vehicle. The AI we envisage knows that this weapon is there, and that it can be used only for very specific purposes, in very specific environments (and of course it knows what those purposes and environments are). At Walmart itself, in the parking lot, any attempt on the part of the would-be assailant to use his weapon, or even position it for use in any way, will result in it being locked out by the AI. In the particular case at hand, the AI knows that killing anyone with the gun, except perhaps e.g. for self-defense purposes, is unethical. Since the AI rules out self-defense, the gun is rendered useless, and locked out. This is depicted pictorially in Figure 1.

Continuing with what could have been: Texas Rangers were earlier notified by AI, and now arrive on the scene. If the malevolent human persists in an attempt to kill/maim despite the neutralization of his rifle, say be resorting to a knife, the Rangers are ethically cleared to shoot in order to save lives: their guns, while also guarded by AI that makes sure firing them is ethically permissible, are fully operative because the Doctrine of Double Effect (or a variant; these doctrines are discussed below) says that it's ethically permissible to save the lives of innocent bystanders by killing the criminal. They do so, and the situation is secure; see the illustration in Figure 2. Unfortunately, what we have just described is an alternate timeline that did not happen - but in the future, in similar situations, we believe it could, and we urge people to at least contemplate whether we are right, and whether, if we are, such AI is worth seeking.

Can This Blue-Sky AI Really be Engineered?

Predictably, some will object as follows: "The concept you introduce is attractive. But unfortunately it's nothing more than a dream; actually, nothing more than a *pipe* dream. Is this AI really feasible, science- and engineering-wise?" We answer in the affirmative, confidently. The overarching reason for our optimism is that for well over 15 years Bringsjord and colleagues have been developing logicist AI technology to install in artificial agents so as to ensure that these agents are ethically correct [e.g. (Bringsjord, Arkoudas, and Bello 2006; Arkoudas, Bringsjord, and Bello 2005; Bringsjord and Taylor 2012; Bello and Bringsjord 2013; Govindarajulu and Bringsjord 2017)]. This research program has reached a higher degree of maturity during a phase over the past six years, during which the second author, Govindarajulu, has collaborated with Bringsjord, and led on many fronts, including not only papers that seek to formalize and implement ethical theories in AIs [e.g. (Govindarajulu and Bringsjord 2017; Govindarajulu et al. 2019)], but also in the development of high-powered automated reasoning technology ideal for machine ethics; for instance the automated reasoner ShadowProver (Govindarajulu 2016; Govindarajulu, Bringsjord, and Peveler 2019), and the planner Spectra (Govindarajulu 2017), which is itself built up from automated reasoning.

Importantly, while all of the longstanding work pointed to in the previous paragraph is logicist, and thus in line with arguments in favor of such AI [e.g. (Bringsjord 2008; Bringsjord et al. 2018)], we wish to point out that other work designed to imbue AIs with their own ethical reasoning and decision-making capacity is of a type that in our judgment fits well our logicist orientation [e.g. (Arkin 2009; Pereira and Saptawijava 2016a)], and with our blue-sky vision. But beyond this, since of course lives are at stake, we call for an ecumenical outlook; hence if statistical/connectionist ML can somehow be integrated with transparent, rigorous ethical theories, codes, and principles [and in fact some guidance for those who might wish to do just this is provided in (Govindarajulu and Bringsjord 2017)] that can serve as a verifiable, surveyable basis for locking out weapons, we would be thrilled.

Why is Killing Wrong?

As professional ethicists know, it's rather challenging to say why it's wrong to kill people, especially if one is attempting to answer this question on the basis of any consequentialist ethical theory (e.g. utilitarianism); a classic, cogent statement of the problem is provided in (Ewin 1972). We are inclined to affirm the general answer to the first question in the present section's title that runs like this: "To kill a human person h is *ipso facto* to cut off any chance that h can reach any of the future goals that h has. This is what makes killing an innocent person intrinsically wrong." This answer, formalized, undergirds the first of our two simulations.

Automating the Doctrine of Double Effect

We referred above to the Doctrine of Double Effect, DDE for short. We now informally but rigorously present this

ethical principle, so that the present short paper is selfcontained. Our presentation presupposes that we possess an ethical hierarchy that classifies actions (e.g. as *forbidden*, *morally neutral*, *obligatory*); see (Bringsjord 2015). We further assume that we have a utility or goodness function for states of the world or effects; this assumption is roughly in line with a part of all consequentialist ethical theories (e.g. utilitarianism). For an autonomous agent a, an action α in a situation σ at time t is said to be $DD\mathcal{E}$ -compliant *iff*:

- C_1 the action is not forbidden (where we assume an ethical hierarchy such as the one given by Bringsjord (2015), and require that the action be neutral or above neutral in such a hierarchy);
- C_2 the net utility or goodness of the action is greater than some positive amount γ ;
- \mathbf{C}_{3a} the agent performing the action intends only the good effects;
- C_{3b} the agent does not intend any of the bad effects;
- $\mathbf{C}_4\;$ the bad effects are not used as a means to obtain the good effects; and
- \mathbf{C}_5 if there are bad effects, the agent would rather the situation be different and the agent not have to perform the action. That is, the action is unavoidable.

See Clause 6 of Principle III in (Khatchadourian 1988) for a justification of clause C_5 .¹ Most importantly, note that DDE has long been taken as the ethical basis for self-defense, and just war (McIntyre 20042014). Our work brings this tradition, which has been informal, into the realm of formal methods, and our second simulation is based upon an AI proving that DDE holds.

Two Simulations

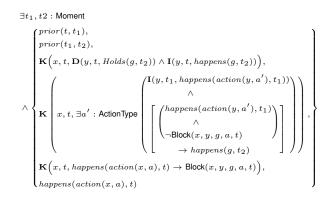
A pair of simulations, each confessedly simple, nonetheless lend credence to our claim that our blue-sky conception is feasible. In the first, an AI blocks the pivotal human action α because the action is (given, of course, a background ethical theory that is presumed) ethically impermissible. Essentially, the AI is able to prove $O(a, \neg \alpha)$ by using a principle of the form $\Phi \rightarrow O(a, \neg \alpha)$. Here Φ says that performance of α by a would deprive an innocent person a' of the ability to continue to pursue, after this deprivation, any of his/her goals. Once the AI, powered by ShadowProver, proves that α is ethically impermissible for a, an inability to prove by $DD\mathcal{E}$ that there is an "override" entails in this simulation that the pivotal action cannot be performed by the human. In the second simulation, the AI allows a human action by

¹This clause has not been discussed in any prior rigorous treatments of DDE, but we feel C_5 captures an important part of DDEas it is normally used, e.g. in unavoidable ethically thorny situations one would rather not be present in. C_5 is necessary, as the condition is subjunctive/counterfactual in nature and hence may not always follow from $C_1 - C_4$, since there is no subjunctive content in those conditions. Note that while (Pereira and Saptawijaya 2016b) model DDE using counterfactuals, they use counterfactuals to model C_4 rather than C_5 . That said, the formalization of C_5 is quite difficult, requiring the use of computationally hard counterfactual and subjunctive reasoning. We leave this aside here, reserved for future work.

DDE that directly kills one (the malevolent shooter) to save four human members of law enforcement (see Fig. 1). Here now is a brutally brief look on the more technical side of the simulations in question.

As discussed earlier, it is difficult to state exactly why it's intrinsically wrong to kill people. Yet we must do exactly this if we are to enable a machine to generate a proof (or even just a cogent argument) that the assailant's gun should, on ethical grounds, be locked. Moreover, we must state this as formulae expressed in a formal logic that an automated theorem prover can reason over. In our case, we utilize the Deontic Cognitive Event Calculus (DCEC) and the aforementioned ShadowProver, respectively. Much has been written elsewhere about DCEC and the class of calculi that subsumes it; these details are out of scope here, and we direct interested readers to (Govindarajulu and Bringsjord 2017), which makes a nice starting place for those in AI. The original cognitive calculus appeared long ago, in (Arkoudas and Bringsjord 2009); but this calculus had no ethical dimension in the form of deontic operators, and pre-dated ShadowProver [and used Athena instead, a still-vibrant system that anchors the recent (Arkoudas and Musser 2017)]. Here it should be sufficient to say only that dialects of \mathcal{DCEC} have been used to formalize and automate highly intensional reasoning processes, such as the false-belief task (Arkoudas and Bringsjord 2009) and akrasia (succumbing to temptation to violate moral principles) (Bringsjord et al. 2014). DCEC is a sorted (i.e. typed) quantified multi-operator modal logic. The calculus has a well-defined syntax and proof calculus; the latter is based on natural deduction (Gentzen 1935), and includes all the introduction and elimination rules for second-order logic, as well as inference schemata for the modal operators and related structures. The modal operators in \mathcal{DCEC} include the standard ones for knowledge K, belief B, desire D, intention I, and in some dialects operators for perception and communication as well. The general format of an intensional operator is e.g. $\mathbf{K}(a, t, \phi)$, which says that agent a knows at time t the proposition ϕ . Here ϕ can in turn be any arbitrary formula.

As to the pair of simulations themselves, while a full discussion of them would not fit within the limitations of this short paper, we do discuss one critical definition next, that of the (abstracted) predicate Prev(x, y, g, a, t), which means that x prevents y from achieving goal g via action a at time t; in a form expressed in DCEC syntax:



The key components in this definition are:

- 1. x knows that y desires a goal g and intends to accomplish g;
- x knows that y intends to perform an action a' that will lead to the accomplishment of y's goal g, unless x does something to block that goal;
- 3. x knows that if x performs action a then y's goal g will be blocked; and
- 4. x performs a.

Utilizing this definition, along with a few other formulae in \mathcal{DCEC} (chiefly, that preventing another human from achieving their goals, unless overridden by \mathcal{DDE} , is forbidden), ShadowProver can prove — on an Apple laptop, and without any human-engineered optimization — for Simulation 1 that lock-out must happen in less than a second, and 3 seconds for Simulation 2 that lock-out must not happen.

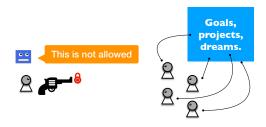


Figure 1: Prohibition Against Killing in Force; AI Thwarts Malevolent Assailant. *This corresponds to Simulation 1*.

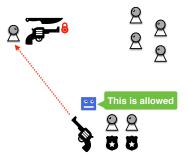


Figure 2: DDE Sanctions Shooting Malevolent Assailant; AI Refrains from Thwarting. *This corresponds to Simulation* 2.

Why Not Legally Correct AIs Instead?

We expect some readers to sensibly ask why we don't restrict the AI we seek to *legal* correctness, instead of ethical correctness. After all (as it will be said), the shootings in question are illegal. The answer is that, one, much of our work on the deontic-logic side conforms to a framework that Leibniz espoused, in which legal obligations are the "weakest" kind of moral obligations/prohibitions, and come just before, but connected to, ethical obligations in the hierarchy \mathscr{EH} , first introduced in (Bringsjord 2015). In this Leibnizian approach, there is no hard-and-fast breakage between legal obligations/prohibitions and moral ones; the underlying logic is seamless across the two spheres. Hence, any and all of our formalisms and technology can be used directly in a "law-only" manner. This is in fact provably the case; some relevant theorems appear in (Bringsjord 2015). The second part of our reply to the present objection is that we wish to ensure that AIs can be ethically correct even in cases where the local laws are wildly divergent from standard Occidental ethical theories.

Additional Objections

Of course, there are any number of additional objections that will be raised against the research direction we seek to catalyze by the present short paper. It is fairly easy to anticipate many of them, but current space constraints preclude presenting them, and then providing rebuttals. We rest content with a speedy treatment of but two objections, the first of which is:

"Consider the *Charlie Hebdo* tragedy, in Paris. Here, high-powered rifles were legally purchased in Slovakia, modified, and then smuggled into France, where they were then horribly unleashed upon innocent journalists. Even if the major gun manufacturers, like the major car manufacturers, willingly subject themselves to the requirement that their products are infused with ethically correct AI of the type you are engineering, surely there will still be 'outlaw' manufacturers that elude any AI aboard their weapons."

In reply, we note that our blue-sky conception is in no way restricted to the idea that the guarding AI is only in the weapons in question. Turn back the clock to the Hebdo tragedy, and assume for the sake of argument that the brothers' rifles in question are devoid of any overseeing AI of the type present in the two simulations described above. It still remains true, for example, that the terrorists in this case must travel to Rue Nicolas-Appert with their weapons, and there would in general be any number of options available to AIs that perceive the brothers in transit with their illegal cargo to thwart such transit. Ethically correct AI, with the power to guard human life on the basis of suitable ethical theory/ies, ethical codes, and legal theory/ies/codes, deployed in and across a sensor-rich city like Paris, would have any number of actions available to it by which a violent future can be avoided in favor of life. Whether guarding AI is in weapons or outside them looking on, certain core requirements must be met in order to ensure efficacy. For instance, here are two (put roughly) things that a guarding AI should be able to come to know/believe:

Epistemic Requirements for Weapon-Guarding AI

Given any human h, at any point of time t, an ethically correct, overseeing AI should *at least* be able to come to know/believe the following, in order to verify that relevant actions on the part of h are DDE-compliant (where ϕ is a

state-of-affairs that includes use of a weapon).

- 1. The human's intentions: $(\neg)\mathbf{I}(h, t, \phi)$
- 2. Forbiddenness/Permissibility: $(\neg)\mathbf{O}(a, t, \sigma, \neg \phi)$

Now here is the second objection:

"Your hope for AI will be dashed by the brute fact that AI in weapons can be discarded by hackers."

This is an objection that we have long anticipated in our work devoted to installing ethical controls in such things as robots, and we see no reason why our approach there, which is to bring machine ethics down to an immutable hardware level (Govindarajulu and Bringsjord 2015; Govindarajulu et al. 2018), cannot be pursued for weapons as well. Of course, a longer discussion of the very real challenge here is needed.

Concluding Remarks

Alert readers may ask why the ", And More" appears in our title. The phrase is there because machine ethics, once one is willing to look to AI itself for moral correctness, and protective actions flowing therefrom, can be infused in other artifacts the full "AI-absent" human control of which often results in carnage. A classic example is driving. We all know that AI has made amazing strides in self-driving vehicles, but there is no need to wait for lives to be saved by broad implementation of self-driving AI: ethically correct AI, to-day, can shut down a car if the would-be human driver is perceived by an artificial agent to be intoxicated (above, say, .08 BAC). In 2017 alone, over 10,000 people died in the U.S. because of intoxicated human drivers used their vehicles immorally/illegally (NHTSA²). Ethically correct AI, indeed relatively such AI, can stop this, today.

We end with a simple observation, and from it a single question: Many researchers are already working on the challenge of bringing ethically correct AIs to the world. Why not channel some of this ingenious work specifically into the engineering of AIs that are employed to guard artifacts that, indisputably, are all too often vehicles for unethical agents of the human sort to cause horrible harm?

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²https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/ 812630

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