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ORIGINAL PAPER

Responsibility Practices and Unmanned Military Technologies

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Abstract The prospect of increasingly autonomous military robots has raised concerns about the obfuscation of human responsibility. This papers argues that whether or not and to what extent human actors are and will be considered to be responsible for the behavior of robotic systems is and will be the outcome of ongoing negotiations between the various human actors involved. These negotiations are about what technologies should do and mean, but they are also about how responsibility should be interpreted and how it can be best assigned or ascribed. The notion of responsibility practices, as the paper shows, provides a conceptual tool to examine these negotiations as well as the interplay between technological development and the ascription of responsibility. To illustrate the dynamics of responsibility practices the paper explores how the introduction of unmanned aerial vehicles has led to (re)negotiations about responsibility practices, focusing particularly on negotiations within the US Armed Forces.

Keywords Responsibility · Military autonomous robots · Unmanned aerial vehicles

Introduction

The recent increase in the use of unmanned aerial vehicles (UAVs) in armed conflict and the ongoing developments in military robotics have sparked debates about the future of war and the ethics of using increasingly intelligent and autonomous technologies (Lin et al. 2009; HRW and IHRC 2012). On the one hand, proponents of the development of these technologies argue that such machines would be able to

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replace human soldiers in “dull, dirty and dangerous” jobs, such as neutralizing explosive devices and performing extended reconnaissance missions. They also envision these technologies to be more discriminating, efficient and effective in performing such jobs. Some even argue that once autonomous robots are capable of moral reasoning they would behave more ethically than human soldiers under the harsh conditions of war, because fear, fatigue, anger, frustration or feelings of revenge would not cloud their judgement (Arkin 2009). On the other hand, more and more ethical concerns surface as these technologies become more prolific. Critics have, for instance, pointed to the risks of lowering the thresholds for governments to engage in armed conflicts or possibly prolonging such conflicts (Sparrow 2009; Singer 2009; O’Connell 2011).

One particular concern that critics have repeatedly voiced is that their will be no one to be held responsible for the behavior of increasingly autonomous military technologies (Sparrow 2009; Singer 2009; HRW and IHRC 2012). An assumption that often underlies this concern is that human actors will not be able to properly control future computer systems and robots, equipped with artificial intelligence and machine-learning software, because the behavior of these machines would be too complex and unpredictable (Matthias 2004). Such concerns about responsibility and the loss of control seem to assume that ‘fully’ autonomous technologies will be an inevitable outcome of current developments and that the more intelligent and autonomous technologies become, the less responsible human actors will be.

However, as studies of technology have pointed out, responsibilities take shape in negotiations between designers, innovators, users and other relevant social groups (Akrich 1992; Latour 1992). Technologies can enable and facilitate certain actions, but they do not determine the actions of users, nor do they determine the distribution of responsibility. I argue in this paper that this also holds for military robots. Whether or not and to what extent human actors are and will be considered to be responsible for the behavior of robotic systems is and will be the outcome of ongoing negotiations between the various human actors involved, including designers and users, as well as scholars, military authorities, human rights groups and politicians. These negotiations are about what technologies should do and mean, but they are also about how responsibility should be interpreted and how it can be best ascribed. An analysis of such negotiations can therefore help to address responsibility concerns while autonomous military technologies are still in the early stages of development and deployment.

I propose that in order to analyze these negotiations, responsibility is best viewed as a set of practices that continuously change over time and under the influence of new technologies as well as social, political and economic developments. The notion of responsibility practices provides a conceptual tool to examine the interplay between technological development and the ascription of responsibility. It refers to the established ways that people, within a particular environment or moral community, understand and ascribe responsibility, based on shared values and ideas about fairness and utility.

As tasks are delegated to new technologies, new responsibility practices have to be negotiated and established. The discourse on (UAVs), also referred to as remotely operated aircraft, unmanned systems or drones, is a case in point. In this paper I will analyze how the introduction of these technologies has been accompanied by negotiations about and the development of appropriate responsibility practices. The aim of this analysis is to show how a closer look at the negotiations about responsibility practices provides a more fine-grained view of the issues at stake and helps to make choices about the distribution of responsibility explicit. First, however, I will discuss the problematic relationship between technology and responsibility to give some background for the subsequent discussion of the notion of responsibility practices.

Responsibility and Technology: A Problematic Relationship

In response to rapid advances in military robotics, critics have argued that taking ‘the human out of the loop’ through increasing automation will limit the ability of those that deploy, use and interact with the technology to control the outcome of events or to reflect on the consequences of their decisions. Sparrow (2007), therefore argues that the development of ever more autonomous military robots is unethical, because no human actor can be held responsible for the deaths that occur in the course of war. He points out that the assumption that we can identify who is responsible for particular actions underlies key principles in Just War theory. We should, for instance, be able to hold an individual accountable when combatants fail to discriminate between legitimate and illegitimate targets and potentially violate the principle of distinction. Yet, when robots become ‘fully’ autonomous, he maintains, human actors will not be able to control let alone understand or predict the behavior of these technologies and can thus not be held responsible for the consequences.

Some critics argue that ascribing responsibility to human operators for unmanned technologies is already becoming a problem. Cummings (2006), for instance, argued that the physical and emotional distance as well as the ‘perceived animacy’ of current day computer systems may create a moral buffer that allows human actors to shirk responsibility. Royakkers and van Est (2010) maintain, based on a similar argument, that those who remotely control military robots from behind visual interfaces cannot reasonably be held responsible for the decisions they make. The sociotechnical system in which they perform their duties, they argue, conditions them to dehumanize the enemy and morally disengages them from their destructive and lethal actions. Operators are physically and emotionally distanced from their enemies, as they perceive the battlefield through interfaces, reminiscent of videogame consoles, on which human targets are represented as a few pixels on a screen. The resulting moral disengagement, according Royakkers and van Est, limits the ability of operators to reflect on their decisions and to fully comprehend the consequences of the use of lethal force. These ‘cubicle warriors’ can, therefore, not be ascribed responsibility, they argue, as comprehending the consequences of one’s actions is a necessary condition to hold someone responsible (p. 292).

Concerns, such as Sparrow and Royakkers and van Est present, assume that control is a necessary condition of responsibility and that as computational technologies become more complex and autonomous individuals will no longer be able to control them enough to consider these individuals responsible. Matthias call this the responsibility gap (2004). He argues that a person can only be considered responsible, "according to our sense of justice", if she has sufficient control over her actions and their resulting consequences. That is, she has to have knowledge of the particular facts surrounding her actions, freely form a decision to act and choose one of a suitable set of alternative actions based on these facts (p. 175). These conditions cannot be sufficiently satisfied, he contends, for certain types of technologies that can act without human intervention. In particular when technologies operate according to rules that the machine itself can change during operation, human designers and operators will not have enough control over the machine's behavior to consider themselves responsible.

Such concerns about responsibility and the loss of control are not new or particular to future autonomous technologies. In practice, the control condition is difficult to satisfy when technology is involved, as various scholars have pointed out (Jonas 1984; Coeckelbergh 2011; Noorman 2012). Human actors are embedded in sociotechnical systems in which tasks are distributed among many human and technological components, which mutually affect each other in contingent ways. The operation of robotics systems, for example, requires multiple engineers, mechanics, and users, whose actions are in turn guided by business interests, policies, regulations and legislation developed by politicians, inspectors, managers, financiers, etc. When something goes wrong it can be a challenge to determine whether it was caused by an external event, a design error, a mistake an operator made, a lack of training or safety precautions as a result of the negligence of management, or all of the above.[1]

The interdependencies within sociotechnical systems affect the extent to which an individual is able to directly control or fully comprehend the outcome of her actions. Individuals tend to be part of a longer chain of human actors and technologies, in which decisions of others elsewhere along the chain limit the choices that they have between possible actions. Their superiors may have instructed them to perform tasks in a certain way. In military organizations, for instance, soldiers act within the confines of mission orders, protocols, rules of engagement created by civilian and military leaders, and international laws (Schulzke 2012). In addition, the technologies that they work with mediate their intentions and actions (Verbeek 2006; Johnson 2006). Developers may have built these technologies with the explicit intention to encourage or restrict particular actions of their users. In turn, developers cannot be fully in control of the outcome of the use technology, as they can never fully anticipate how people will use their products or under what conditions. Moreover, the inner workings of many of today's technologies tend to be too complex and difficult to comprehend by any single developer or user (Van den Hoven 2002). Coeckelbergh, therefore, notes that: "Technological action is not a matter of having either full control or no control. We

[1] Carrigan et al. (2008) provide an illustration of the interdependencies and the distributed responsibilities that make it a challenging endeavor to figure out who and what caused a UAV crash to occur. As the paper shows a pilot error is often also the result of various mishaps and oversights by other human actors, such supervisors and interface designers.

usually have some control. […] Therefore, where technological actions is concerned the question is not whether or not a person is responsible, but to what extent a person is responsible” (2011, p. 42).

Ascribing responsibility when technology is involved can be difficult, but that does not mean that no human actor is responsible (Nissenbaum 1994). When it comes to making people answerable for the consequences of the use of technology, all kinds of strategies have been developed to deal with uncertainty and the limited control that individuals have,. There are legal constructs like ‘due care’ and ‘no fault’ to attribute blame or call upon individuals or companies to make amends for untoward events. For example, strict liability law designates that certain individuals or organizations may be accountable when something goes wrong, even if the designated person or organization could not exactly anticipate all possible negative consequences. These laws are codified norms that reflect generally accepted ideas about control, authority and duties. They suggest that even if someone could not directly control or comprehend the outcome of her actions, her actions and decisions did influence the outcome of events to some extent and she should therefore be held to account. Such strategies reflect particular, often less strict, notions of control.

The various kinds of strategies to ascribe responsibility are not only legal constructs; they may also be part of the formal or informal norms within organizations[2]. For instance, within various professions, like the medical and engineering professions, ethical codes provide a guide for members to act responsibly, even though they may only have limited control of the outcome of events. Informal behavioral norms within organizations articulate expectations about responsible behavior or about how individuals can hold others to account.

As the above shows, technology and responsibility influence each other in various ways, which can make it difficult to ascribe responsibility to individuals or groups. The challenges that the development of autonomous technologies pose for responsibility, in this respect, are thus not new. However, these technologies do have the potential to exacerbate these difficulties and they may require their own strategies for addressing these difficulties.

Responsibility Practices

The various strategies to hold people responsible in the face of uncertainty are part of responsibility practices. I use the term responsibility practices here to refer to the established ways that people, within a particular environment or community, understand, evaluate, and ascribe responsibility. These practices involve accepted ways of evaluating actions, holding others to account, blaming or praising, and conveying expectations about obligations and duties. They pertain to the various

[2] Even when technology is not the main issue, we have responsibility strategies that do not require direct control. The notion of command responsibility in military organizations stipulates that commanding officers are responsible for the actions of their unit. Although they cannot directly control the actions of the men and women under their command and the technologies they work with, they are responsible for creating the conditions for soldiers to behave appropriately (Doty and Doty 2012).

kinds of responsibility, such as accountability, role responsibility, legal responsibility, and moral responsibility.

Responsibility practices build on shared moral frameworks. In most communities someone is considered to be acting responsibly when they adhere to prevailing norms and moral principles, and when their actions reflect shared values. Such norms, principles and values can be formally constituted through laws, codes of ethics, rules or protocols as well as informally negotiated in daily social interactions. Within a moral community, individuals and groups are expected to act according to these ideas about how to behave and they can be held to account when their actions violate them. Values like loyalty, integrity and honor, for example, guide the training and everyday actions of individual US Army men and women as well as the interactions between them. In this community it is, for instance, understood that soldiers have a responsibility to be honest and honorable and to dedicate themselves to carrying out their unit's missions. When they fail to live up to these expectations, they can be called upon to answer for and explain their actions, and their answers may lead to blame and punishment.

Responsibility practices can be both forward- and backward-looking (Ladd 1989; Gotterbarn 2001; van de Poel 2011). Forward-looking responsibility practices articulate and reify expectations about future tasks and duties. Such expectations might be spread through instruction manuals, ethical codes, observation of past practices, training programs, directives, policy, regulations, laws etc. When members of community fail to live up to these expectations, accepted accountability mechanisms allow others to call upon these members to explain and justify their actions. These backward-looking responsibility practices involve the various ways in which actions are evaluated, accountabilities established and blame or praise attributed. When a serious accident occurs with an experimental autonomous car on a public road, for example, local authorities may launch a formal investigation; an affected individual may sue the car company for damages in court and managers and project leaders within the company might call for an emergency meeting to question developers about what happened and determine whether there were any wrong doings.

Once established, responsibility practices are continuously challenged and renegotiated as new view points are brought to bear or as a result of external forces. One external factor that can challenge existing practices is the introduction of new technologies, because they tend to change the way people do things and lead to new arrangements of things and people (Akrich 1992). As mentioned, technologies can facilitate and enable new actions or attitudes, while constraining, discouraging and inhibiting others, which may lead to shifts in responsibilities. Take for example automated public administration systems; the introduction of an automated system may limit the decisions that human bureaucrats lower in the hierarchy had before, while it may increase the responsibilities of their superiors and the developers of the systems (Bovens and Zouridis 2002). However, it may also lead to the obfuscation of responsibility as a result of a lack of accountability mechanisms (checks and balances) to make superiors and developers answerable for their actions and decisions.

The lack of experience with new technologies can affect the extent to which individuals or groups of individuals are held accountable. In order to operate a new technology effectively, users typically have to go through a process of training and familiarization with the system. It requires skill, knowledge and experience to understand and imagine how the system will behave (Coeckelbergh and Wackers 2007). The lack of understanding can cause confusions about who is responsible for what. However, as developers, operators, users and others become acquainted with the possibilities and limitations of the technologies, expectations about what various human actors should or should not do may further evolve. Thus, someone might have been excused for accidentally releasing a computer virus in the early days of the Internet, when few people knew of the effects it could have, but as our understanding of these technologies has grown expectations about what people ought to know and how they should handle these technologies have shifted (Friedman 1990).

Moreover, new technologies allow people to do things they could not do before, which often implies that there are no clear rules and norms in place yet to regulate this behavior. Ladd notes, in regard to computer technology, that it "has created new modes of conduct and new social institutions, new vices and new virtues, new ways of helping and new ways of abusing other people" (Ladd 1989, p. 210–11). The social or legal conventions that govern these new modes of conduct may take some time to emerge and the initial absence of these conventions triggers discussions about who can be held responsible and for what.

The above indicates that distribution of responsibility is not just dependent on the delegation of tasks to automated technologies, but also on the practices that have been established to ascribe responsibilities. As technologies are introduced in existing organizations, activities, roles and norms change and new ones are created. Technologies, in turn, are further shaped as they are made to align with existing practices and prevailing values and interests (Bijker et al. 1987; Hackett et al. 2008). In this process of mutual shaping responsibility practices are challenged and renegotiated.

This has also been the case for UAV technologies. Since UAVs are relatively new and are introduced into contexts in which humans performed parallel tasks before, negotiations about responsibility practices are currently taking place. Human actors delegate more and more tasks to the automated systems that allow unmanned aircraft to fly without pilots onboard, such as navigation, flight control and system health monitoring (US DoD DSB 2012). As these technologies make new kinds of activities possible for the US Armed Services, they put existing practices under strain and trigger discussions on multiple levels about responsibility. In the following sections I will take a closer look at how the delegation of tasks to these unmanned systems affects and shapes responsibility practices within military organizations.

Delegating Tasks to Unmanned Systems

To fully understand how responsibility practices have taken shape around UAVs would require an analysis of the many different kinds of unmanned aircraft and their use within their broader cultural, organizational, economic and political context. In the following, however, I will focus on armed UAVs, like the Predator and the Reaper, and their use by the US armed services, because much of the debates on UAVs centers on the use of these kinds of aircraft. Moreover, in this paper I will look primarily at the developments within armed services to provide an initial insight into how responsibility practices take shape around operators and the technologies in use.

I should also note that it is difficult to examine what exactly happened when UAVs were introduced, because much remains classified about US unmanned operations. Nevertheless, a few reports shed some light on the new landscape of activities and networks of human actors and technologies involved in the unmanned operations, including accident reports and research reports on operators of drones (see for example Manning et al. 2004; Williams 2004; USFOR 2010; Chappelle et al. 2010). Based on these reports, I will first look more closely at the delegation of tasks to unmanned systems. In the following section, I will then explore in what way this delegation has affected responsibility practices.

The various reports on UAVs show that the delegation of tasks to automated systems does not simply replace human pilots. Armed UAVs automate a number of tasks previously performed by human actors, such as flight control and navigation between waypoints. During many phases of the flight the human pilot has a monitoring role, making sure the system works correctly, while the autopilot controls the aircraft. Armed UAVs, nevertheless, still need a pilot, sensor operator and a mission intelligence coordinator on the ground to perform a number of tasks.[3] Many of these tasks are similar to tasks performed in a manned aircraft, such as ensuring that everything is operating efficiently and effectively, and coordinating with air control and ground forces (Ouma et al. 2011). Despite the sophisticated automation of current day UAVs, unmanned aircraft pilots also still have to perform a number of manual controlling tasks, such as maneuvering the aircraft for surveillance, reconnaissance and the deployment of weapons as well as for avoiding bad weather or controlling the aircraft when the system or equipment fails.

Rather than replacing the pilot, unmanned technologies have enabled the redistribution and creation of new sets of tasks. As a result of the new capabilities that unmanned technologies offer, the flight crew of UAVs now perform a number of tasks that pilots of manned aircraft did not do before. One of those tasks is to identify and track possible targets on the ground, using various sophisticated sensors, before deciding whether or not to take out the target. Unmanned aircraft make it possible to monitor large areas for hours on end and collect massive amounts of intelligence data. UAVs like the Predator and the Reaper can stay in the air for more than 24 h and loiter above a certain area. The crew can follow suspected enemy combatants and monitor their movements in order to determine the threat level and decide on whether, how and when to launch a missile. After the release of a missile they can go back and assess the damage. This combination of

[3] For an overview of the tasks of the pilot and sensor operator of a MQ-1 Predator and the MQ-9 Reaper see (Chapelle et al. 2010, 2011).

surveillance and targeting tasks is a unique combination in air combat operations that was not possible before (Asaro 2013).

The design of the technology and the new combination of tasks that unmanned technologies have made possible have changed the activities of human actors involved, when compared to manned aircraft. Focusing on the pilots of the unmanned aircraft for a moment, even though they perform a number of tasks that are similar to those of a pilot of a manned aircraft, their activities are different in various ways. They are located in a ground control station from which they remotely operate the aircraft via satellite links. They cannot look outside to orient themselves or feel the physical feedback from the aircraft itself. Instead, they have to rely on video images and sensor read outs to control the aircraft. Some pilots have compared it to flying an aircraft through a soda-straw (Defense Industry Daily 2010). Unlike pilots in manned operations, they also have to analyze and make decisions about the behavior of individuals on the ground based on camera images and other sensors. Moreover, they perform their tasks during shifts that can last up to 12 hours and that are often uneventful or even boring (Cummings et al. 2013).

Another difference with manned aircraft is that the crew of an unmanned aircraft has to continuously coordinate with a number of other human actors that have access to the same visual information. They work closely with other military personnel on the ground and in the air for identification and discrimination of targets and deployment of weapons. Through chat messages or voice links, they receive information from command centers and data analysts in an information fusion center that simultaneously process the volumes of data that the sensors onboard the UAV generate.

The creation of new activities and tasks brings with it a transformation in decision-making processes and in relationships between the individuals. Asaro (2013) argues that, as a result of the unique capabilities of current armed unmanned systems, roles previously performed by multiple human actors have been compacted and compounded. He points out that decision-making in unmanned operations has become a more shared activity and less compartmentalized, as compared to manned operations. In manned operations tasks and decision-making are clearly delineated and isolated from each other. The pilot flies the aircraft and decides when to pull the trigger, while image analysts and commanding officers tend to choose the target. The roboticist and former fighter pilot, Cummings, also points out that fighter pilots used to have considerable autonomy in making decisions (The Economist 2012). Pilots would often make their own decision whether or not to strike, as there were no video-links between cockpits and command centers and, sometimes, even radio contact would not be possible. Cummings claims that western countries now practice "warfare by committee". In unmanned operations decisions are made in a process that involves a number of people that have access to the same information and that coordinate with each other in real-time. She notes that even government lawyers may be part of these real-time decision-making processes to call off strikes that are illegal or would "look bad on CNN".

The delegation of tasks to unmanned technologies changes human activities and decision-making throughout the broader sociotechnical network, rather than that they supplant a few human actors. Although the accounts discussed in this section focus primarily on the flight crew of UAVs, and briefly allude to the tasks of others like commanders and mission intelligence coordinators, activities have changed and new roles have been created for a larger number of human actors. It can take up to 168 people, including a crew for landing and take-off, several crews for flight, technicians and maintenance personnel, to keep a Predator in the air for 24 h (Cloud 2011). Of course, the role of developers, procurement officers, policy makers and many others has been left out completely, but it is not unreasonable to assume that their roles have also been affected in many ways as well. The changing activities and arrangements between people directly affect practices of responsibility, because they influence the expectations about what individual actors should or should not do. They also affect the ways that people hold each other to account.

Yet, the delegation and redistribution of tasks alone tells us little about responsibility. The human actors involved in unmanned operations have a considerable incentive to perform their tasks well because of the high risks of a threat to human life, national security, foreign relations, or military operations, as well as the potential loss of a multimillion-dollar aircraft (Ouma et al. 2011). However, the extent to which they are perceived or feel in a position of responsibility depends on prevailing norms and expectations about duties and obligations, as well as on existing mechanisms to evaluate and judge behavior.

Unmanned Technologies Trigger Negotiations About Responsibility Practices

As mentioned, when new technologies are introduced, established ways of ascribing responsibility may be reconstituted. This has also been the case for unmanned technologies. Practices had to be established to govern the new activities and to clearly designate who was responsible for what. All the new activities and relationships between human actors that unmanned technologies enabled, required their own particular protocols, procedures, rules, training programs, job descriptions, etc. New ideas and expectations about human performance as well as technological requirements had to be formulated.

Reports on accidents involving UAVs shed some light on the responsibility practices already in place. When serious incidents occur, such as a fatal accident, the inadvertent loss of civilian life or deaths resulting from friendly fire, the Armed Services launch an investigation to figure out what happened and who should be held accountable (Williams 2004). Such reports are themselves part of existing backward-looking responsibility practices. They follow from and constitute formal and informal procedures to retrospectively determine what went wrong and who or what failed to behave appropriately. The pages of descriptions detailing the chain of events can serve as basis to determine punishment and make adjustments to conventional ways of doings things in order to minimize the chance of reoccurrence. Investigations may lead to new procedures, or enhancements in training programs.

At the same time, accident reports reflect forward-looking responsibility practices already in place, involving prevailing values and norms as well as expectations about appropriate behavior. Although few reports on incidents involving UAVs are available, one report of an incident in Uruzgan, Afghanistan in 2010 provides some relevant illustrations. The summary of the report recounts the events that contributed to the death of 23 Afghan civilians, including women and children (USFOR 2010). The civilians were killed when a helicopter airstrike on three vehicles, was authorized on the basis of information received from a Predator crew based in Nevada. The investigative report, ordered by General McCrystal, reflects expectations about the behavior of human actors involved and their duties. For instance, the investigators blamed the Predator crew for their "inaccurate and unprofessional" reporting (p. 1). The Predator crew had mistakenly identified the vehicles as hostile and had "ignored or downplayed" any information indicating that they were not (ibid.). The crew, according to the investigators, did not behave as they were expected to behave and according to their duties: they did not provide the ground force commander the information he needed to properly determine whether the vehicles where a threat. The investigators also blamed the commanders for not immediately reporting the civilian casualties, as required. The commanders should have reported the suspected civilian deaths when it became clear directly after the attack that the occupants of the vehicles were not enemy combatants. The analysis in the report, thus, demonstrates ideas about how human actors were supposed to behave, what information they were supposed to communicate to other actors and how they were expected to relate to each other.

The incident and the investigative report also show that the established practices continue to be adjusted and negotiated. After mistakes occur investigations of what happened are commonly used to make adjustments to existing practices in order to prevent these mistakes from happening again. This was also the case for the investigation of the Uruzgan incident. Based on the investigation, General McChrystal ordered that six officers be reprimanded and asked the Air Force to further investigate the Predator Crew (USFOR 2010, p. 3). He also recommended a thorough review of training practices for aviation crews as well as commanders. Pre-deployment and on-site training should better educate command posts and leaders of counterinsurgency formations about responsibilities and engagement criteria, using case studies, vignettes, investigations, and articles, about the targeting process. Furthermore, the General recommended that the Air Force would codify command level guidance on unmanned tactics, techniques and procedures and conflict resolution. The sweeping review of training practices and procedures was intended to better install a sense of professional responsibility and to adjust existing practices such that they more clearly articulate expectations about permissible and appropriate behavior. They served to adjust and strengthen forward-looking responsibility practices.

Negotiations about responsibility practices may be about adjusting training practices or procedures, but they can also be about the relation between various actors when it comes to decision-making. As a result of the new arrangements between people that new technologies make possible, practices have to be established that specify how and by whom decisions are made, and thus where responsibility ultimately lies. As pointed out before, the ability to interact with multiple individuals that have access to the same data makes decision-making in a ground control station a more shared activity. This may raise questions about how decisions are made and who should interact with whom and when.

One report on an incident in Iraq illustrates some of the questions that the new relations between the various actors involved in unmanned operations raise (USFOR 2011). In this incident two US soldiers died after the crew of a UAV and the ground commander mistakenly identified them as enemy combatants. Data analysts in the Distributed Ground Station, who were monitoring the same images as the UAV crew was, identified the two soldiers correctly as coalition forces. However, their concerns never reached the crew. The mission intelligence coordinator, in charge of overseeing the communication between the various people involved, failed to relay the private chat message he received from the data analysts to the pilot or the people on the ground. One of the recommendations in the investigative report was that information pertaining to possible violations of the Laws of War (LOW) or Rules of Engagement (ROE) or friendly fire events should be broadcasted more widely to those involved in making a strike decision (p. 19). They suggested that data analysts should have the ability to converse with the Predator pilot and the ground commander directly in order to alert them to conflicting information. However, this recommendation raises the question of how much interaction should take place before someone finally makes a decision in situations where events unfold quickly. As Air Force Maj. General Otto, commander of the Air Force Intelligence, Surveillance and Reconnaissance Agency, stated in the Air Force Times.

> There's a point when a discussion's over. And while we always want somebody to have the ability to speak up when they fear a rule-of-engagement violation or wait a minute, there's women and children, you have to balance fighting a war by committee with a ground-force commander who is presumed to have the situational awareness and has the authority to say, we need to strike this target. (Laster and Iannotta 2012, p. 5).

The General's comments illustrate that new technologies and arrangements between people can lead to different viewpoints about how decisions should be made and what the duties of those involved should be.

Another topic in negotiations about responsibility practices, as some reports show, concerns the required competencies of the human actors involved. As described above, unmanned technologies create new tasks and activities. In the absence of a thorough understanding and experience with using these technologies, expectations of what operators are supposed to be capable of and what they should know are still developing. Pavlas et al. (2009), for example, argue that not enough attention has been paid to the knowledge skills and abilities that UAV operators require, while Chappelle et al. (2011) note that the understanding of psychological attributes considered to be critical for successful job performance in unmanned operations is still limited. Current insights are primarily based upon pilots operating manned aircraft. Yet, unmanned operations seem to require that the humans involved have a specific and different set of capabilities. Various researchers have started investigating what the various capabilities of pilots and sensor operators are or ought to be (see for example Ouma et al. 2011; Petkosek et al. 2005). Chappelle et al. (2011), for example, argue that operators should have "a higher than average cognitive proficiency with notable strengths in the areas of coordination, attention/vigilance, spatial-processing/analysis, reasoning/task prioritization, and situational awareness" (p. 17). Such reports reflect ideas about what the duties of human actors ought to be, e.g. they have to carefully analyze video images and coordinate appropriately with others, but they also articulate ideas about what it would take for human actors to effectively perform their tasks and fulfill their duties.

Negotiations about responsibility practices can be about what is expected of the human actors involved, how those expectations can be promulgated and how actions can be evaluated, but they can also be about the technologies themselves. The growing familiarity with and understanding of the possibilities and limitations of a new technology may lead to the fine-tuning of the technology. This has also been the case for armed UAVs. They were initially rushed onto the battlefield (Whittle 2011). Designers were primarily concerned with making sure that the aircraft would stay in the air, and that it could be remotely controlled through satellite linkages. In its report The Role of Autonomy in DoD Systems, the DoD Defense Science Board Task Force (2012) argues that this strategy has hampered the effective use of unmanned technologies. It states that that "The Task Force found that research and acquisition have focused primarily on navigational capabilities, essentially gaining reach, but research and acquisition efforts have not led to developments in perceptual processing planning, learning, human-robot interaction or multi-agent coordination, that would assist in the effective use of that reach" (p. 22). This suggests that the design of the interaction between operators and the automation did not have a high priority. In fact, several other reports showed, confusing and opaque interfaces have contributed to a relatively high number of mishaps (see for example Williams 2004 and Gertler 2012). In response to these shortcomings more attention has been given in recent years to the human factors issues involved in operating remotely piloted aircraft (RTO 2007). In the US DoD's 2011 Roadmap for unmanned systems, for instance, more emphasis has been placed on such things as "designing the entire autonomous system to support the role of the warfighter and ensure trust in the autonomy algorithms and the system itself" (US Department of Defense 2011, p. 46). The blame for mishaps is thus not entirely placed on human operators, but on the design of the technology as well. The growing awareness of the limitations of increasing machine autonomy with regards to human performance and responsible behavior has affected the design of technology, in the sense that more attention is given to the development of technologies that better support human decision-making and control.

The negotiations about the various aspects of responsibility practices are, thus, part of the processes of mutual shaping between technology and society. The introduction of a new technology challenges existing responsibility practices, while these practices—as well as the values, norms and rules that they are based on—influence the development of the technology. In conducting their operations, for instance, operators of unmanned aircraft in the US armed services are bound by the Laws of War. These established international laws set a standard for appropriate conduct in armed conflicts and for the evaluation of the actions for those involved in these conflicts. They also provide principles for the development and use of technologies. Take the principle of distinction. In order for them to be lawfully used, new technologies would have to allow soldiers to distinguish between combatants and civilians (Sharkey 2008).

Nevertheless, the meaning and significance of established values, norms and principles, such as expressed in the Laws of War, are also the subject of negotiations, which affects the negotiations about responsibility practices. Shared assumptions about what is appropriate or morally acceptable may be challenged not only by the introduction of new technologies, but by social, political and economic developments as well. The current discussions about transparency and accountability of the US drone strategies and policies are a case in point. According to international and national law there should be oversight and accountability for drone strikes. The US executive branch, however, seems to have adopted a controversial interpretation of what that entails. Critics, including several human rights groups as well as members of Congress, have taken exception to the reluctance of the US to be transparent about its decision-making processes and its justifications for its strategies. For example, members of Congress have pointed out that although the Central Intelligence Agency (CIA) is generally assumed to conduct a considerable number of drone operations outside of official conflict areas, such as Pakistan and Yemen, little is publicly known about the decision-making processes (Kucinich et al. 2012). This lack of transparency and public accountability may influence how practices of responsibility around these technologies take shape (Columbia Law School and the Center for Civilians Conflicts 2012, p. 55). The absence of public checks and balances may lead the CIA to take bigger risks and stretch the limits of international laws beyond what others would find acceptable. At the same time, the growing critique on these developments can pressure those in charge to redefine current policies regarding accountability.

Negotiations about how to best distribute and enact responsibility, thus, take place on many different levels within and outside of military organizations. They involve a variety of actors, including governments, civil society organizations, academic researchers, defense contractors, journalists and the broader public. To illustrate some of the dynamics of responsibility practices, I have primarily focused on negotiations with military organizations. It is important, however, to point out that negotiations about responsibility practices extend further. They may also, for example, include discussions about the duties and obligations for manufacturers and developers, or about the legal framework for dealing with liability issues. As more and more decision-making processes are automated, manufacturers and developers make choices that up until recently have been the exclusive domain of military organizations; choices about distinguishing combatants for targeting, for instance. This raises questions about their responsibilities and accountabilities (Fitchelberg 2006). How and when should manufacturers be held to account when technologies fail to provide the information a commander needs to make a decisions? To what extent should developers be considered to be in control of the behavior of the technology? What duties and obligations do they have, and which values should they adhere to? Once they start programming computers to make lethal decisions should their activities be under Congressional scrutiny? Similarly, implicit and explicit choices about the responsibility of soft- and hardware testers, procurement officers, policy makers, media organizations, etc. with regard to unmanned technologies are currently being negotiated and made. In order to have a well-informed debate about how responsibility should be ascribed to human actors, these choices need to be made explicit.

Conclusion

The development and use of unmanned technologies raises considerable concerns about responsibility. One important concern is that as these technologies become more autonomous and more complex, human actors can no longer be reasonably held responsible or accountable. Some even argue that ascribing responsibility is already problematic in current unmanned operations. These concerns may turn out to be justified, but, as I have argued in this paper, whether or not human actors will be held responsible for the behavior of unmanned or autonomous technologies is not an outcome of technological development alone. Rather, it is also the result of negotiations between various actors involved in the development and use of these technologies about what it means to be held responsible and how to act on responsibilities. It is a choice that humans make, rather than an inevitable result of delegating tasks to technologies.

The introduction of a new technology, like UAVs, may change human activities and the relations between people. As a result, they may influence how responsibility practices—i.e. the established ways of holding people to account and of conveying expectations about duties and obligations—take shape. However, they do not determine these practices. Rather, various groups and individuals, including researchers, government and military officials, manufacturers, activists, journalists and lawyers, negotiate what these practices should look like. Based on their experience with and understanding of the technology and their often conflicting interests and values, they put forth their ideas about how to best establish rules, norms and laws that govern the activities that these new technologies make possible. They also develop conceptions of what it means to be held responsible as well as discuss what kind of technologies that requires.

Discussions about the future of unmanned technologies should therefore explicitly take into account how social practices can be organized around technologies such that responsibility is clearly assigned to human actors, and how technologies can be developed that support such practices. Responsibility should thus be a part of both the technical design as well as the design of the broader sociotechnical system. Analyses of current negotiations about responsibility practices can help to bring into view the discussions and choices that are already being made.

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