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(Dis)Placed Workers: A Study in the Disruptive Potential of Robotics and AI

WeRobot 2018 Working Draft

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I. Introduction

Many discussions around the future of work focus on whether or not certain jobs will be eliminated by AI and robotic technologies. However, there are fewer discussions about how those technologies will disrupt the conditions of jobs that continue to exist. By assuming a future *absence*, all the ways in which work practices *remain present* is obscured. But we should be skeptical of claims that machines will obviate humans; studies of previous transitions in the history of automation demonstrate that new technologies do not so much do away with the human, as obscure the ways in which human labor and social relations are reconfigured (Durkheim 1997; Ekbia and Nardi 2017; Noble 1984; Marx 1990; Suchman 2007).

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Framing the future implications of robotic and AI technologies around reconfiguration rather than replacement opens new spaces of investigation. How does the law and other formal and informal mechanisms of accountability recognize the new actors who work alongside machines? In what ways and to what extent are human actors obfuscated when "intelligent systems" are deployed? How are issues of responsibility for successful or negative outcomes distributed and adjudicated? In what ways are evaluations and cultural narratives of value, expertise, and identity repositioned in the face of increased automation and AI systems?

This paper investigates how working with automated and "intelligent" machines could disrupt labor practices and professional expertise through an ethnographic analysis of US Air Force (USAF) drone operations, with a focus on the changing work of USAF drone pilots. My analysis, based on over fourteen months of fieldwork with communities involved in the deployment of USAF drone operations located within the US, suggests that human infrastructures of unmanned drone operations are obscured while also remaining quintessential to their operation.[2] As drones promise a path towards autonomous AI systems, such autonomy only emerges by masking the human labor and networks that create and maintain it.

I propose that this storyline will be increasingly common in the context of deploying AI and robotic systems: The human actors who work alongside, with, and through automated systems are undervalued and rendered invisible. This, in turn, destabilizes formations of identity, skill, and expertise, with consequences for regimes of value, responsibility, and knowledge

[2] The fieldwork referenced in this paper was conducted as part of my dissertation research between 2010-2015. Fieldwork included conducting interviews with retired as well as active-duty Air Force officers and enlisted service members, defense contractors and other professionals employed within the drone industry, as well as academic and military research scientists and engineers. I also attended industry conferences, networking events, lab meetings, protests, and job fairs. The irony of writing about the variously visible infrastructures of war within the United States without identifying any particular places is not lost on me. Unfortunately, both legal and ethical concerns outweigh, at this time, providing more specific and localized accounts of the places I visited and people with whom I spoke.

production. To articulate this pattern, the paper begins by outlining a set of categories and framing questions through which to analyze the potential disruptions of automated and "intelligent" systems in the context of work practices. I then present a case study on the introduction of drones in contemporary Air Force operations. While this case is specific to the US military context, in my discussion I revisit the categories of disruption and suggest the ways in which these categories might apply in other contexts where AI and robotic systems are being deployed.

Throughout this article, I purposefully integrate the terms AI, autonomy, robotic, and automated into an overlapping cluster of concepts. Both autonomy and artificial intelligence usually refer to activities or processes that were previously carried out by humans, but both terms are variously defined in technical and public discourses. The term automation, as defined by leading researchers in human factors engineering, refers to "a device or system that accomplishes (partially or fully) a function that was previously, or conceivably could be, carried out (partially or fully) by a human operator" (Parasuraman, Sheridan, and Wickens 2000). These researchers have also proposed a framework for designing and analyzing automated systems through varying *levels* of automation, rather than an all-or-nothing assessment. This framework of levels of automation, with full machine autonomy on one end of a continuum, has become the predominant way of describing automated and autonomous systems in engineering and robotics fields. Rooted in the basis of automation, AI, robotic, and autonomous technologies can be understood to exist on a spectrum. For the purposes of this paper, I do not focus on their specific distinctions, but rather aim to integrate a wider phenomena of technologies that in some way approximate (and promise to stand in for) human action or judgment.

II. Types of disruption

In this section, I sketch five categories through which to examine how robotic and AI technologies are likely to produce disruptions to individuals and communities in the context of work. These categories are not comprehensive, but are those that allow us to bring into focus most clearly the particular ways in which AI systems will impact practices and lived experiences of "intelligent" technologies.

1. Agency

Historical examinations demonstrate that the introduction of new automated technologies create new formations and distributions of agency—as well as potentially incorrect attributions of agency (Mindell 2000, 2015; Elish and Hwang 2015). Traditionally, conceptions of agency have been linked to freewill and the inherent capacities of independent actors (Ahearn 2001). In this conception, there is a clear correspondence between an actor and the action that stems from her own will. Critiques of traditionally conceived agency have suggested a more complicated relation between actors and "their" actions. For instance, recent debates have centered on the agentive capacity of non-human actors and within the field of STS and Actor-Network Theory, the co-constitution of agency within socio-technical systems has been a central point of theorization (Latour 1993; Barad 2007; Bennet 2010; Suchman 2007). My use of the term agency is indebted to these conceptions of locating agency as an emergent relation, but is grounded in a pragmatic position that humans should be understood as having a unique form of agency which emerges from the capacity to be held accountable for an action. Moreover, my interest is not in the agency of any actor *per se* but rather how and to what extent the agency of a human actor is "abducted" within the social world (Gell 1997); how are new agencies that emerge from within technological systems ascribed to human actors?

2. Responsibility and recognition

Responsibility and recognition reference the extent to which an actor may be held responsible for his or her action and be held accountable accordingly. If we think about responsibility as both the capacity to be held accountable for negative consequences as well as to be attributed positive consequences that result from one's actions, praise, in addition to blame, is a productive way to trace new formations of responsibility. Here, responsibility refers not just to the capacity to be blamed, but also to the capacity to be recognized as the responsible agent, for good or bad, in the form of guilt, shame, praise, or pride.

By creating new divisions of labor and distributions of agency, robotic and AI technologies will disrupt existing social perceptions of responsibility and legal frameworks of accountability (Citron and Pasquale 2014; Jones 2015). When working alongside "intelligent" or robotic machines, how are existing forms of accountability and modes responsibility disrupted and with what consequences?

3. Skill and knowledge

In her classic study of automation in the workplace, Shoshana Zuboff (1988) highlighted the ways in which computer-mediated work changed the grounds upon which knowledge could be claimed and exercised. Knowledge of a service or manufacturing process was primarily constituted not through embodied and tacit knowledge of machines or interpersonal relationships as it had once been, but rather, through the ability to manipulate and control abstract representations of processes through computers. This shifting basis of knowledge, in turn, caused

a cascade of consequences for everyday work practices, work hierarchies, and the ways in which these hierarchies were destabilized and then reinforced.

Focusing on skill and knowledge objects opens up new areas of inquiry around the introduction and potential destabilizations of introducing digital "intelligent" technologies in work contexts. That the introduction of new technologies will necessitate the acquisition of new skills is not surprising. More subtle, however, is the observation that these skills may differ not only in type, but also in kind. Skills may require new forms of mastery over different kinds of knowledge objects. In addition, the grounds for what constitutes useful and valuable information and skill changes. In the case of Zuboff's customer service employees, this meant learning about computer work, not just interpersonal relations. This focus also allows us to ask questions about who will be most likely to benefit from these new formations of skill. For instance, a forthcoming study by my colleagues at Data & Society around platform technologies as mediators and managers of work practices demonstrate that workers must also learn to become entrepreneurial subjects, managing their "brand" and all aspects of self-promotion (Mateescu, Rosenblat, and Ticona 2018). Are the new skills required explicitly recognized as skills? Which populations are at an advantage to take on these new skills and how are the resources required to excel differently distributed?

4. Control and authority

A prominent area of investigation around the social impact of robotic and AI technologies has involved the new formations of control and surveillance that these technologies afford. Enactments of control and surveillance are inextricably intertwined with the history of automation, and the developments of new digital technologies have entrenched this relationship

(Rosenblat, Kneese, and boyd 2014). Central to Zuboff's study was the analysis of the new relations of power and techniques of control that emerged alongside computer mediated work, as well as the hierarchies of authority that were destabilized and reconfigured. Recent work articulating the algorithmic management practices at stake in labor platforms and the gig economy (Rosenblat and Stark 2016) demonstrate that the ways in which control over work may be obscured but remain fundamentally intact. However, it is also important to keep in mind the ways in which workers resist and reconfigure control and surveillance practices (Levy 2015). What formations of control and authority are uniquely afforded by robotic and AI systems?

5. Identity

The preceding categories are relatively familiar terrain in discussions of robotic and AI technologies in the context of work. Less common in these conversations is the critically important relationship between new forms of work and individual or community identity. However, there is a rich history of sociological inquiry into the relationship between work and identity, and this research suggests several insights. First, as prominent sociologist of work Steven Peter Vallas summarizes in his overview of the field, the sociology of work has demonstrated the simple but profound arguments that work is "consequential for human life, both individually and collectively" and "work cannot be viewed as a mere economic transaction, or as the outcome of technological imperatives" (Vallas 2012: 6). The conditions and consequences of work are inextricably intertwined with every aspect life, and have profound implications for physical and psychological well-being (Kohn 1969, 2006; Kohn and Schooler 1983). Understood within the context of this body of research, examining the potential disruptions of identity that may result from the introduction of robotic and AI technologies

becomes a way to bring into sharp focus the implications of technological change as a consequential human activity that exceeds an economic evaluation.

Formal and informal mechanisms of expressing, embodying, or attributing identity may be implicated. Questions of identity include not only explicitly professional or work identities, but also how those identities exist within intersectional categories like race, gender, and class. As Sennet and Cobbs's (1972) classic study articulates, identity and feelings of self-worth and dignity at work are complexly constituted; the stories that workers tell about value and worth come not only from professional accomplishments but also from the ability to be a provider and protector. Also at stake are the formal ways in which workers' identity are defined. For example, as technologies transform work, new kinds of workers emerge that may not fit into existing categories of worker, as the US debates about whether platform workers for ride-sharing apps are independent contractors or employees demonstrate (White 2015). How will affinities with or rejections of particular identities influence technological adoption and how workers are valued, by themselves and by society?

III. Case study: Drone pilots and the reconfiguration of Air Force military work

1. "Unmanned" aircraft in the US Air Force

The deployment of drones, known also as Unmanned Aerial Vehicles (UAVs) or Remotely Piloted Aircraft (RPA), has become increasingly central to US military strategy since 2001. The term drone may refer to a wide range of aerial vehicles.[3] In this paper, I refer to what

[3] There are many classes of drones, ranging from the size of insects to the size of commercial airplanes. The Firebee drone, along with the Lightning Bug, was one of the first "unmanned aerial vehicles" built in the 1950s and was used as a target drone for targeting practice. For a comprehensive history of military unmanned aerial vehicles, see Ehrhard (2000) and Chandler (2014).

are termed "large and high altitude" drones. Currently, US drone operations consist of two distinct programs: one is run by the Department of Defense (DoD) under the various military forces, including the Air Force, which oversees the largest percentage of drone operations. These DoD drone operations generally are coordinated with troops on the ground, through military tactics known as "close air support." The CIA runs the other program, publicly unacknowledged until 2013. Debates over the constitutionality of "targeted" killings of US citizens overseas, as well as citizens of other countries with which the US is not officially at war, most directly apply to the CIA program. Immense secrecy continues to surround the CIA program, and while public discussions and debates surrounding the program inform my arguments, my focus in this paper is specifically related to Air Force operations, those within which my ethnographic work was situated.

Even as the Pentagon had its overall budget decrease during the Obama administration, and even as the wars in Iraq and Afghanistan are presented as nearing an end, the operational demand for drones is expected to continue to increase, according to drone industry analysts and official statements from all the military forces (Powers 2017; Yost 2013). In 2001, Congress invested approximately $667 million for unmanned aerial systems (UAS) procurement. By FY2012 the DoD had requested approximately $3.9 billion for Unmanned Aerial Systems (UAS) procurement and development (Gertler 2012), with budgets steadily increasing each year. Many both within and beyond the Pentagon are convinced that drones are the future of warfare (Bowden 2013; Zegart 2015).[4]

[4] This holds true for both the Air Force, which operates in "conventional wars" where the United States has publicly declared war in Iraq, Syria, and Afghanistan, and for the CIA, which conducts classified and often covert operations outside the areas of "conventional war" zones, including Pakistan, Libya, Somalia, and Yemen (Shane 2016).

For both officers and enlisted service members, positions related to Remotely Piloted Aircraft (RPA) have been among the most heavily deployed in recent years (Losey 2016). Since 2011, the US Air Force has been training more drone pilots than traditional pilots (Gertler 2012). However, despite Pentagon planning for increases in the number of drone flights, the Air Force announced in 2015 that it would reduce the proposed number of flights due to insufficient numbers of trained pilots (Drew and Philipps 2015). This personnel shortfall highlights the substantial and undeniable human resources that are required to operate and maintain drones.

Although drones are often described as "unmanned," over 210 personnel are required to operate a drone. While the scene of two young men sitting in a trailer in the desert in the western United States is the typical image of what it takes to operate a drone, that trailer, known as the Ground Control Station (GCS), is only one node in an immense physical network through which drone are deployed. Distributed around the globe, there are computers, screens, keyboards, sensors, ballistics, orbiting satellites, and underwater fiber optic cables, all designed, managed, deployed, and maintained by specialized personnel. In addition to the pilot, operator, and mission commander who operate from within the United States in places like Nevada and New York, information analysts, in places like Florida and Virginia, review and coordinate military assessments that direct mission priorities. If a bomb is to be released from an Air Force operated drone, military lawyers will be involved in assessing the target, referring to judging potential civilian causalities. In order to carry out the standard 24-hour operation for an MQ-1 Predator or MQ-9 Reaper, a newer and more complex version of the Predator, four aircraft are required with 61 personnel forward deployed, meaning physically near the zone of flight operation, and 149 personnel operating from within the continental United States (Kreuzer 2014: 169). In total, 210 personnel are required. The number of drone personnel, including aircrew, intelligence, aircraft

maintenance, and communications maintenance, has more than quadrupled since 2005 (USAF 2014: 18). And this is only counting one side of the people directly involved—that is, not counting the individuals and communities who are under surveillance and threat of attack during that shift. In every regard, drones are far from "unmanned."

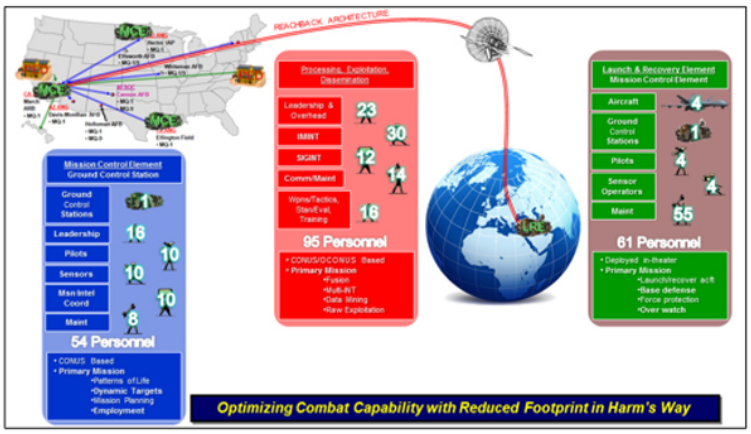

Figure 1: USAF MQ-1 Predator/MQ-9 Reaper manning diagram (Krezuer 2014: 169)

As a complex sociotechnical system, the development and deployment of drones must be understood as embedded within specific social and historical dynamics. To emphasize the human actors and social relations at stake, I employ the term "drone operations" (Elish 2017), rather than the more common term "drone" as the salient object of analysis. The extensive human and technical infrastructures required to operate and maintain drones are elided when reduced to the figure of the drone, as is common in the popular media and much scholarly work. Attention is tuned to the object, rather than the system through which its operation is enabled. This framing moves away from a hardware-centric idea of an isolated object, and asks us to examine the infrastructures and surrounding networks that create, sustain, and authorize drone operations.

This paper looks only at a small piece of the immense network implicated in drone operations, that involving the drone pilot. While incomplete, this narrow view allows us to see in

detail how the introduction of a so-termed "unmanned" automated and robotic technology affected the work of Air Force pilots. This paper also foregrounds dynamics around military work and professional identity, while leaving relatively undiscussed other implications of this network and dynamics around the use of military force and the constitution of the military within American culture, which are the beyond the scope of this paper.[5]

2. *Consequential action without consequential agents: Contradictions around agency, responsibility, and identity*

While the liability, and morality, of those who operate drones is often a point of scholarly debate, questions of legal liability for harmful or inappropriate deployments of weapons by Air Force officers are relatively straightforward in the sense that they are treated like any another existing weapon systems.[6] Targeting and weapons deployment on unmanned aerial platforms has not occasioned the necessity to reformulate pilot liability. The deployment of drone operations as a distributed and preemptive mode of war, as a form of legal state violence, has come under scrutiny but is beyond the scope of this paper.[7] However, the agency of officers involved in

[5] In previous work I have touched on these implications (Elish 2017, 2018), contributing to an expanding literature on the conditions and implications of drone warfare (c.f. Amoore 2009; Gregory 2011; Shaw and Akhter 2012; Asaro 2013; Satia 2014; Chamayou 2015; Tahir 2016; Weber and Suchman 2016.)

[6] Interestingly, issues of culpability and liability have emerged most acutely not around robotic or automated deployments, but around those involving military contractors. For a discussion of the legal debates around "inherently governmental functions" see Keric D. Clanahan, 2013. "Wielding a 'Very Long, People Intensive Spear': Inherently Governmental Functions and the Role of Contractors in US Department of Defense Unmanned Aircraft Systems Missions." *The Air Force Law Review* 70 (November): 119–202.

[7] A detailed analysis of these legal frameworks and the evolution of "lawfare," which are also invoked in Military Operations Other Than War, the concept itself formalized into the acronym MOOTW, are unfortunately beyond the scope of this article. However, a line of inquiry that would investigate the genealogy of these new laws of the "new wars" (Kaldor 2013) would provide an important perspective on the use and potential for abuse of state power. Jaffer (2016) argues, in his introduction to a recently released edited collection of official legal documents pertaining to the drone programs, that the efficacy of the legal justifications during the expansion of the drone programs under the Obama administration is founded on the "perceived trustworthiness of its officials" (30). While legal scholars have for some time

drone operations, and the modes of responsibility and recognition available to drone pilots has been disrupted in other ways. A controversy over medal commendations provides a starting point for unpacking the misunderstandings and contradictions around agency and responsibility that emerged alongside the deployment of "unmanned systems" operations.

In February 2013, then Defense Secretary Leon Panetta announced the creation of a new medal, the Distinguished Warfare Medal, which would recognize significant contributions that "directly impact on combat operations, but that do not involve acts of valor or physical risk that combat entails." The Distinguished Warfare Medal—the first new medal to be created since World War II—came in response to the increasing strategic importance of and operational demand for drone operations during combat, alongside the inability for such contributions to be recognized with existing medals. For instance, in 2010, Col Eric Mathewson, who was the wing commander at Creech Air Force base, had nominated airmen in his wing for the Distinguished Flying Cross, but the nomination had been rejected. In a *Washington Post* article later that year, Mathewson, an experienced fighter pilot who would go on to be a leader in the RPA USAF community, told a reporter, "Valor to me is not risking your life. Valor is doing what is right. Valor is about your motivations and the ends that you seek. It is doing what is right for the right reasons. That to me is valor" (Jaffe 2010). Valor, for Mathewson, should not be linked to physical risk or bravery.

The response to the Distinguished Warfare Medal was swift and pronounced. The Veterans of Foreign Wars (VFW) were among the most vocal, arguing that the new medal would diminish the significance of the existing awards for valor in combat because the Distinguished

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debated the legality of the drone programs in the context of international law, to my knowledge Jaffer's essay is unique in its critical articulation of the deployment of laws—not particular laws, but the idea of the law—as a consequential infrastructure of drone operations. Further research from legal, anthropological, and historical disciplinary perspectives would be valuable.

Warfare Medal would be "ahead of," that is ranked above in status, the Bronze Star, awarded for bravery under fire, and the Purple Heart, awarded for those wounded or killed in action. The argument was that no medal for *merit* should be ranked above that for *valor*, merit in this context referring to extraordinary performance and valor referring to risk of life.

Panetta passionately defended the decision, arguing that even as the reliance on "remotely piloted platforms and cyber systems" had grown, there was still no way "to recognize that kinds of contribution" (Panetta 2013). While the Air Force and the DoD supported the medal, most military and veteran communities ridiculed the idea. One article in the *Stars and Stripes* observed that the medal was being referred to as the "Nintendo medal" or the "Purple Buttocks" (Shane 2013). A widely circulated image that "went viral" on military blogs showed a digitally altered image of the proposed medal: a miniature gold Xbox video game controller hanging below the Bronze Star's red, white and blue ribbon (Ingersoll 2013).

Figure 2: "Viral" digitally rendered image of "Nintendo Medal" (Ingersoll 2013)

A few months after the announcement of its creation, the medal proposal was quietly withdrawn by the newly appointed Secretary of Defense Chuck Hagel. Rather than a new medal, drone pilots became eligible for existing medals, (including the Distinguished Flying Cross, earlier denied in 2010) with an attached newly designed ornament, known as a "device," similar

to a small pin attached to a medal, indicating merit in non-combat roles. According to Defense Secretary Hagel's statement, combat medals will remain reserved "for those service members who incur physical risk and hardship of combat, perform valorous acts, or are wounded in combat or as a result of combat" (Shinkman 2013). In January of 2015, the DoD announced the creation of the specific "R" device, which would represent "remote," and which could be awarded for RPA or cyber operations.

During a conversation about the Distinguished Warfare Medal with two young Majors who had been test-pilots, a highly selective career path within the Air Force, I was told that the controversy was silly: "Medals don't mean anything anymore."[8] They found the whole thing to be an empty show for the media. Nonetheless, they acknowledged that medals and other forms of commendation play an important role in career advancement within the military. Medals aren't linked to heroism, they implied, but they are linked to how far you will advance in your career as an officer. They are a formal mode of recognition, validating not only a military success but also the value of the individual who performed it. The controversy demonstrates the existing dimensions of what is perceived as the most honorable military service today—physically fighting in combat. In addition to this, the controversy is an example of how formal modes of recognition and responsibility were made unavailable to drone pilots.

In order to understand the magnitude of change at stake, it is necessary to clarify the pre-existing status and perceptions of fighter pilots in the Air Force, and the ways in which identity is inextricably intertwined with the work officers perform. The figure of the fighter pilot remains a

[8] As Air Force officer Michael Kreuzer (2014) argues, the development of decorations for military service, first established in 1918, has been an evolving structure that has traditionally taken into account new modes of warfare and the unique needs of the services at different moments in time as techniques for improving morale. In the past decade, medals also conversely have emerged as empty placeholders, being devalued through "medal inflation." (Moran 2004; Kreuzer 2014: 193-194). This perception is supported by conversations I had in the field.

powerful force especially in the context of military recruitment (Brown 2012) and the fashioning of Air Force organizational identity (Builder 1989). For example, during my fieldwork multiple pilots told me that as "ridiculous" and "inaccurate" as the movie *Top Gun* is in portraying what it's like to be a fighter pilot, that movie sparked their desire to be a pilot. One fighter pilot, who now commands a drone squadron told me, "Those first few minutes [of *Top Gun*]? It's not like that at all, and now we know that. But man, we're all like, 'Yeah!' I love that movie." Another former test pilot told me it was "the best movie on the planet. Nothing in it is real. But it's so much fun." Even though the reality of flying differs from the fantasy, the imagination of the fighter pilot contributes to the perceived mystique (Fino 2017).

In contrast, "unmanned" drone pilots emerged as antithetical to traditional fighter pilots. Originally equated with playing video games, piloting a drone did not require the same demands of physical strength, bravery, or sacrifice, and moreover, were seen to be skill-less and anchored to the ground, subject to a clunky computer system.[9] For instance, an apocryphal story I heard during fieldwork was about how the first Predator pilots in Nevada were treated by their fellow airmen. Apparently, there was once a prank that involved placing a banner announcing, "Leper Colony," over the trailer from which they operated. The joke made explicit the predominant perception of drone operations, that no one wanted to be near them and that it was where officer careers went to die. I never was able to confirm the truth of the story, but many stories of ignominy from "the early days" still circulate among Remotely Piloted Aircraft (RPA) communities. I was told repeatedly how Predator pilots were the butt of jokes and sometimes open hostility from fighter pilots. While drone operations were becoming increasingly central to

[9] A community of officers attempted to frame drone operations as yet another iteration of pilot skill and expertise being rearticulated around a new set of technologies, attempting to recuperate the perceived aspects of expertise and individual autonomy. See the work of Cullen (2011), Blair (2012, 2015), Kreuzer (2014), among others.

military strategy in Iraq and Afghanistan in the 2000s, and drone hardware was demanding increasing budget lines, drone crews remained generally disregarded. To become a fighter pilot is to become part of an elite group, one to which nearly all aspire; but to become a drone pilot is to be placed in an outcast group.

This was not only a matter of social perceptions, but also structural decisions within the Air Force with very real organizational consequences. For instance, the Air Force did not officially recognize RPA pilots as a career track until 2011. Career tracks, and their particular paths of promotion, are the foundation of any officer's career, that is, employment from a minimum of several years to the maximum of thirty years. Career tracks are both a way to ensure specific training and to specify how advancement will occur, including what certifications or experiences need to be gathered before moving on to another position. To not officially recognize RPA pilots as a career track was to codify what many fighter pilots and even "the top brass" informally conveyed: to be an RPA pilot was an utterly worthless assignment, with no skill and no value. Organizationally, the upper management of the Air Force did not think, or was unwilling to recognize, drone pilots internally as relevant actors with status worthy of formal recognition. Only in 2011, ten years after the first remote split Predator operation, did the Air Force create a unique career track for RPA pilots, known as 18X (Clark 2012).

This is not surprising given that since its creation with the National Security Act of 1947, the United States Air Force has been an organization dominated by pilots in senior management positions, and also by fighter pilot culture, even though fighter pilots represent a very small fraction of the Air Force (Fino 2017; Kreuzer 2014). Perhaps because of the dominant pilot perspective, the Air Force was originally resistant to even the use of what were then termed

UAVs, unmanned aerial vehicles, and very few fighter pilots wanted to make the switch from "manned" to "unmanned" platforms. Some volunteered, but many were transferred unwillingly.

The impact of drone operations on perceptions of masculinity likely contributes to an underlying anxiety around "drone pilot identity." Indeed, a common term for drones figuratively emasculates the concept: "*unman*ned aerial vehicles." Piloting a drone does not require physical acts of bravery nor is it seen to require physical strength or skill, all attributes that have traditionally demarcated masculinity, especially in military contexts (Higate 2012). Alongside the overt absence of physical risk or sacrifice, which undercuts existing conceptions of warrior masculinity, drone operations require intimately working with computer keyboards and screens. While allusions to "video game warriors" may present an infantilized image of drone pilots, more subtle and substantial is the complex legacy of gendered perceptions of computing. On one hand, weapons technology, as well as other technological systems like aircraft, are gendered masculine and evoke power, dominance, and mastery (Cohn 1987). In addition, technical computer expertise and the capacity to create, develop, and repair computer systems also are currently activities with masculine connotations and predominantly performed by men (Margolis and Fischer 2001; Crawford 2016).

On the other hand, even as idealized hegemonic masculinities are shifting in the context of digital technologies, these shifts must be actively constructed and disruptions must be repaired through various discursive mechanisms (Ely and Meyerson 2010; Filteau 2014). Sitting in front of a computer to work can be perceived as "geeky" or "nerdy," the opposite of a masculinity rooted in physical power and stamina. Again, the legacy of the Air Force, as the force that has always placed the role of advanced technology at the core of its self-image and recruitment

techniques (Brown 2012: 54), makes the connections between technology and masculinity familiar, but perhaps all the more fragile.

3. Enlivening the system: Skill, knowledge, and control

During my field research, the articulation of "professionalism," professional skill, and professional identity was a common theme. In the face of perceptions that operating a drone was worthless and required no skill, the pilot community attempted to position the work of drone pilots as meaningful and skillful service (Blair 2012). One window into this repositioning is a PhD dissertation from MIT by USAF Major Tim Cullen, which provides a detailed, albeit redacted, account of pilot and sensor operator training at Holloman Air Base, New Mexico in 2010. Through an ethnography of pilot and sensor training, Cullen articulates how the skill and knowledge production at stake in drone operations takes shape. For instance, Cullen explains that pilots and operators learn to cultivate feelings of "remote presence" by learning to "build a picture" and become the "malleable and adjustable coordinating tissue of the system" (Hutchins 1995: 219, quoted in Cullen 2011: 119), explicitly building on Edward Hutchin's theory of distributed cognition. His analysis emphasizes the role of social team dynamics and human operator skill, especially in the face of poorly designed technological systems and inefficient bureaucracies.

Cullen also emphasizes the workarounds that pilots and sensors develop, and the initiative and expertise that they embody. Cullen describes the extensive languages and techniques that crews develop during their training to master the poorly designed system of the "finicky" (215) ground control station (GCS) prone to systems failure (202). In fact, lacking standardized modes of transferring knowledge, such as manuals, learning how to most

effectively use Predator drones and pass on that knowledge to new pilots and sensor operators was an inefficient and particularly embodied practice (214). [10] This circumstance echoes what Suchman, in non-military contexts, has articulated as the unique "enlivening" (Suchman 2007: 256) aspects of humans that support "autonomous" robotics. While the context is different, I would argue that the pattern that Suchman observes is relevant here: autonomous and automated systems, while imagined—and presented—as operating independently and flawlessly, attain this status "through the camouflaging of the networks that support them" (Suchman 2007: 215).

While potentially limited in his analysis given his own commitment to build a foundation of respect for drone crews, his analyses of human-machine interactions aligns with other arguments that have emerged from within the social studies of technology and science about how working with technological systems entails particular knowledge sets and embodied skill (Hutchins 1995; Prentice 2012; Vertesi 2015). While Cullen's aim is to demonstrate the skill and value of drone crews, his analysis also underscores the extensive human animation and translation that drone operations require in order to produce military intelligence.

The networks of humans and machines implicated in drone operations necessitate new skills and the development and manipulation of new knowledge products. They also enabled new forms of control over the pilots themselves. Drones, as a quintessential technology of what became known in military circles as the Revolution in Military Affairs (RMA), emphasizing the use of digital sensing and information networks in order to increase the speed, accuracy, and reach of military operations, are also a quintessential technology of surveillance. As "an eye on the sky," the use of drones promises to see in order to control all that is below. Their original use

[10] Aircraft manuals are significant documents that detail an aircraft's technical specifications and specific use and maintenance procedures. In the aviation industry, such manuals are critical parts of training and skill maintenance. In this sense, when General Atomics did not provide manuals to the early Predator crews, a predominant professional norm was violated.

for surveillance over enemy populations produced unintended affordances for other types of surveillance and remote control by management, a kind of "refractive surveillance" (Levy and Barocas 2018). For instance, the Predator drone was first used in the Balkans for surveillance, with the ability to stream directly from the battlefield to the Pentagon, so-called "CNN in the sky." (Cockburn 2015a: 63) This had a profound impact within the Pentagon about what was believed could be known about the battlefield and by whom (Canan 1999). Journalist Andrew Cockburn has reported that General Wesley Clark was particularly obsessed with "drone TV," and would micromanage generals in the field, reportedly calling a commander to ask at one point, "when are you going to do something about those two Serb tanks sitting at the end of that bridge?" (Cockburn 2015b)

While information networks were intended to decentralize decision-making and allow units increased flexibility to react to changing environments, military strategists have argued that such networks proved to retrench and centralize command. The question quoted above from General Clark demonstrates that when "high-level commanders have such a detailed operating picture they are tempted to meddle and 'micromanage' tactical engagements" (Betz 2006: 520). Ideals of de-centralized command and control end up being reconfigured in practice, and the acts of surveillance are often under surveillance, themselves.

4. Knights vs. Employees: Refiguring identity and value

Drone operations, as technologies that displace humans, potentially destabilize not only professional identity or skill, but also the very economic livelihoods of officers, as well as their surrounding communities. During my fieldwork, I observed an irreconcilable tension—namely, that the military labor of drone operations bears increasing similarity to other forms of

contemporary civilian work, characterized by the language of compensation, flexibility, and insecurity. In particular, my fieldwork brought me in contact with several Air National Guard bases with units conducting 24/7 drone operations. Several commanders I spoke with on these bases gave me the sense that the Air Guard, as a labor pool, was being taken advantage of. One colonel explained, "We have gone from being a reserve component to more of an operational reserve."

While the reliance on the Army National Guard and Reservists became visible during the most intense years of the wars in Iraq and Afghanistan, less attention has been paid to the increasing role of the Air Guard in Air Force operations. While sometimes commanders would passionately articulate this new role for the Guard as a benefit of the job, as "no joke—saving lives on the ground every day," as one commander put, sometimes they would equally passionately articulate what they often felt were the perverse economics of employing Air Guard personnel.

By law, every state, as well as the District of Columbia, Puerto Rico, Guam and the US Virgin Islands, have an Air and Army National Guard that are under the jurisdiction of the state governor as the state's militia, but which are also available as a federal military reserve force.[11] Every guard member is required to serve one weekend a month and go through two weeks of training a year. However, many will serve more than this. According to the Veterans Authority (VA) website, "National Guards and Reserves generally spend two years of their six-year enlistment performing full-time active duty" (VA 2017).

[11] Since the mid-1970s and the end of the draft, the Air Force has officially followed the doctrine of "total force integration," relying on overseas deployment by the Guard. In the ten years following 2001, National Guard personnel have been mobilized more than 700,000 times in support of the overseas missions in Iraq and Afghanistan and domestic missions, some more than once" (CSIC 2011: 4).

The flexibility of deploying Guard units has far-reaching consequences, including many that mirror widespread changes in the post-Fordist constitution of work as "flexible" and "on-demand. To see the consequences, it is necessary to understand that there are three possible statuses for an Air Guard member: (1) State Active Duty, (2) Title 32, and (3) Title 10. Under (1) State Active Duty a Guard member is under the command and control of the governor, and all salaries and benefits are paid by the state. Under (2) Title 32, referring to the federal statute, a Guard member is under the command and control of the governor, but the majority of the funds that pay for salaries and benefits come from the federal government. The Air Guard works under Title 32 when it responds to a natural disaster like a flood or earthquake. Finally, under (3) Title 10, a Guard member is "federalized," and is under the command and control of the President. Air Guard members are cheaper to employ than active-duty, especially when under Title 10.

The calculus is not dissimilar to that of part-time employees who can only receive full-time benefits after a certain number of hours. While being under Title 32 is the equivalent to being on active-duty, and all salaries and benefits are paid by the federal government, under Title 10, a Guard member is paid a base salary for the hours worked equivalent to that received by those on active-duty.[12] However, additional benefits, such flight bonuses, or housing allowances (Basic Allowance for Housing, BAH) and cost of living allowances only accrue after thirty days of active-duty service (Curtis 2007).[13] Air Guard personnel fall under Title 10 when operating

[12] All the compensation for members of the military is based on pay grade and years of service and is updated yearly as part of the national defense budget. To provide a sense of the range of salaries in 2016: a mid-ranking officer (Major, pay grade O-4) with over six years of service could earn a basic pay of $71,604; a mid-to-high ranking officer (Colonel, pay grade O-6) with over twelve years of service could earn $92,668; a high-ranking officer (General, pay grade O-8) with over sixteen years of service could earn a basic pay of $142,992. For comparison: a mid-ranking enlisted (Senior Airmen, pay grade E-4) with over six years of serve could earn $36,403.

[13] Due to shortages of drone pilots, in 2016 the Air Force offered retention bonuses to drone pilots for committing to four years of service of $35,000 a year, ($175,000 over four years) (Losey 2016). Air Guard and Air Reserve members are not eligible.

drones, but if their service is kept just under thirty days, they become cheaper, piecemeal workers. Representing the official position of the National Guard Bureau, McKinley emphasized the role that the Guard could play in "responding to our country's budgetary crisis and to help[ing] maintain our national security." He also called attention to the unique aspects of the National Guard as a labor-pool, emphasizing the benefits of an on-demand, part-time work force, saying "An as-needed force, nearly 85 percent of the National Guard is part-time. National Guard members cost approximately one-third that of their active duty counterparts, especially when we're not mobilized. … National Guardsmen and -women serve longer and retire later than their active duty counterparts and that retirement costs one-tenth of the active duty. (CSIC 2011: 15). In times of budgetary insecurity, according to the Pentagon, as well as global insecurity, the National Guard represents the ideal on-demand, "flexible" (Martin 1997) low-cost labor force.

Operating drones has been a growing mission for the Guard, whose inventory of drones grew from one aircraft in early 2009 to 48 as of the beginning of 2015, with more to be added (Guerra and McNerney 2015: 10). In the coming years, Air Guard forces will have the capability to fly 20 to 25 percent of all the RPA combat air patrols for the Air Force (Matthews 2015: 26).

"This mission is 24/7," was a refrain I heard often, sometimes describing the crucial role that drone operations play in contemporary military strategy, but equally often describing the pace and stress of drone operations as daily work. Being over-worked, as well as stressed or "burned out" was not only the register at Starr, but also among commanders at other bases with whom I spoke or who gave presentations or briefings at public conferences. One major, Simon, who has about to start a new position in command of a "surveillance-only" drone wing emphasized how the Air Force regulations around drone crews had gotten it all wrong. The Air Force treated RPA crews as if they were not deployed in the sense that crews were required to

keep up on training. When pilots are deployed in combat positions, they do not have different requirements for additional training. The bottom-line was that drone pilots had even more responsibilities and time commitments to keep up, even though they were being deployed full-time, suggesting that Command didn't see their deployment *as deployment*.[14]

5. Discussion

The dynamics and destabilizations described above hold several layers of profound consequences. One set of consequences relates to the processes by which a perpetual state of war is normalized – and in particular, the ways in which the humans involved in the waging of that war are obscured. For instance, I have described how drone operations communities have

[14] This same type of language is central to the publicly available reports on the health and mental health of drone pilots. Several reports from the early 2010s described not the existence of PTSD, but rather the existence of "occupational burnout," which led to an increased susceptibility to PTSD (Ouma, Chappelle, and Salinas 2011; Chappelle et al. 2013, 2014). Media reports emphasized the role of PTSD, but the reports themselves were written from the perspective of "occupational stressors." To date, all the studies of mental health in RPA communities have been conducted under the auspices of the Air Force. By and large, the studies concluded that there were significant mental health issues, described as occupational stress and occupational burnout, which shared some symptoms of a PTSD diagnosis, but these were due to constant shift changes and operational tempo. The one study that did state that drone *pilots* (not including sensor operators) suffered as high rates of PTSD as manned pilots relied on electronic medical records from the VA over a long period of time (2003-2011) and included a relatively small and unrepresentative sample size (Otto and Webber 2013). The rates of PTSD for the pilots, most of whom had been deployed previously, was slightly higher than the national adjusted average for American adults. Media reports of PTSD from drone operations (only as voiced by sensor operators, not pilots) have been described by operators who have left the Air Force and who have stated they are under great pressure not to speak (Power 2013). In sum, information, whether individual anecdote or officially sanctioned results conducted by the Air Force itself, seem inconclusive. during my fieldwork, the language of PTSD was a foreign imposition. Whether because of the stigma associated with PTSD diagnoses and its detrimental effects on military careers or whether because it was relatively rare among the communities I visited, such trauma or what one Air Force psychologist described to me as "existential trauma," was not brought up. While some officers expressed doubts over American foreign policy decisions, all believed that they were part of protecting the United States from terrorists who wanted to harm Americans. As such, they believed that they were doing the right thing to make the world a better place. More salient was the language of ordinary, contemporary work life: financial compensation, flexible scheduling, in/security, stress, and burnout. Such mundane and generalized complaints stood in stark contrast to the ideals and idealism expressed at other times.

struggled to make their presence visible and recognized as consequential within broader Air Force and military communities. I would argue such struggles over visibility and recognition are consequential to understanding not only how forms of military service are changing, but also how and to whom the ongoing war is made visible to Americans outside military communities. While heroes glorify war, they also make it visible, and while structures of formal recognition may serve to normalize war conduct, they also call attention how it is being conducted and by whom.

In addition to these political consequences, the introduction of drone operations as an automated and semi-autonomous technology may hold examples for the potential kinds of disruptions that will occur in contexts beyond the military. Consequential disruptions to norms around identity and gender, for instance, are likely to play out in industries like trucking, farming, and nursing. Disruptions and contradictions around remunerated skills and knowledge will affect low-wage workers in retail, as well as potentially professionalized contexts like healthcare. The deployment of "intelligent" and robotic systems in the field of clinical healthcare, for instance, is likely to produce disruptions around the conditions of individual agency, identity, responsibility and recognition, as well as skill, knowledge, and authority. For instance, recent work by Matthew Beane (2018) demonstrates the ways in which the introduction of new robotic surgery technologies disrupts existing modes of training for young surgeons and potentially negatively impacts professional skill development in both the long and short term. In turn, the destabilization of formal and informal training mechanisms relates directly to the ways in which processes of certification or professional oversight may be disrupted. These areas of misalignment and tension are valuable to study in order to effectively develop processes of governance around AI technologies. Without understanding the potential invisibilities and

inequalities that may arise, it will be difficult to fully weigh the harms and benefits of introducing new technologies, hindering the ability to assess appropriate and misappropriate uses.

Still, disruptions to industries, workplaces, or social environments will affect different groups and populations disproportionately. In many cases, disruptions will have negative effects for some groups and positive effects for others. For instance, while pilots may tend toward thinking of drone operations as a dead-end career, many sensor operators have been reported thinking of the assignment as a positive career placement (Cullen 2011; Mindell 2015: 142). From another vantage point, the DoD considers the ability to deploy drone operations relatively cheaply, in terms of strains on financial resources and public perception, as an immense net positive.

It is also worthwhile pointing out that while the technologies discussed involve some form of "intelligent" technology, none are truly autonomous, and many might take issue with whether any of these technologies actually involve "artificial intelligence." This discussion has drawn on historical or parallel examples with similar dynamics from which we might draw relevant inferences. Moreover, it is also perhaps worth pondering the extent to which the descriptor of "autonomous" or "AI" is always already a moving target, and that when we discuss the potential autonomy or intelligence of future technologies, we too easily jump toward an assumption of their existence, rather than facing what these technologies require to exist at all. In general, mass media reporting of autonomous and artificially intelligent technologies tend to present AI technologies as far more sophisticated and robust than they are in practice, over-estimating the capacities of machines and under-emphasizing the necessary roles of humans and essential limitations of the systems (Stanford 2016; Elish and Hwang 2016). As Lily Irani has

observed, while most media discussions elide the role of humans or frame it as a temporary obstacle that will soon be solved by computers, this kind of human work is *constitutive* of "intelligent" systems (Irani 2015). In other words, when we presume that technologies will be intelligent or autonomous *at some point*, what else are we assuming? And are those assumptions the right ones to be basing future decisions on?

IV. Conclusion

The real and imagined disruptions of increasingly automated work that will unfold over the coming decades will have profound implications. From the everyday experiences of individual value and worth to the priorities of federal legislation and resource allocation, the reconfigurations of work will have widespread impact. Current public discussions about the future of work, driven by mass media coverage, tend toward the hyperbolic, in turn, influencing policy and industry priorities in ways that are not necessarily relevant or useful. This paper contributes to efforts to shift the ways in which the future of work and the rise of machine intelligence are understood. By providing both new empirical data, as well as proposing a framework for articulating the resulting disruptions, this paper aims to engage with a range of discussions around policy priorities, legal frameworks, and stakeholder decision-making processes.

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V. Bibliography

Ahearn, Laura. 2001. “Language and Agency.” *Annual Review of Anthropology* 30: 109-137.

Amoore, Louise. 2009. “Algorithmic War: Everyday Geographies of the War on Terror.” *Antipode* 41 (1): 49–69.

Asaro, Peter. 2013. “The Labor of Surveillance and Bureaucratized Killing: New Subjectivities of Military Drone Operators.” *Social Semiotics* 23 (2): 196–224.

Barad, Karen. 2007. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Durham, NC: Duke University Press.

Beane, Matthew. 2018. “Shadow Learning: Building Robotic Surgical Skill When Approved Means Fail.” *Administrative Science Quarterly* (forthcoming).

Bennett, Jane. 2010. *Vibrant Matter*. Durham, NC: Duke University Press.

Betz, David J. 2006. “The More You Know, the Less You Understand: The Problem with Information Warfare.” *Journal of Strategic Studies* 29 (Summer): 505–533.

Blair, Dave. 2012. “Ten Thousand Feet and Ten Thousand Miles.” *Air & Space Power Journal* 26 (3): 61-69.

———. 2015. “Any Time, Every Place: The Networked Societies of War Fighters in a Battlespace of Flows.” *Air & Space Power Journal* 29 (5): 15–30.

Bonafide et al. 2013. “Beyond Statistical prediction: Qualitative evaluation of the mechanisms by which pediatric early warning scores impact patience safety.” *J Hosp Med* 8: 248-253.

Bowden, Mark. 2013. “The Killing Machines.” *The Atlantic*. September. Accessed May 3, 2017. https://www.theatlantic.com/magazine/archive/2013/09/the-killing-machines-how-to-think-about-drones/309434/.

Builder, Carl H. 1989. *The Masks of War: American Military Styles in Strategy and Analysis*. Baltimore, MD: Johns Hopkins University Press.

Brown, Melissa T. 2012. *Enlisting Masculinity: The Construction of Gender in US Military Recruiting Advertising during the All-Volunteer Force*. New York: Oxford University

Press.

Chamayou, Grégoire. 2015. *A Theory of the Drone*. Janet Lloyd, Trans. New York: The New Press.

Chandler, Katherine. 2014. "Drone Flight and Failure: The United States' Secret Trials, Experiments and Operations in Unmanning, 1936 – 1973." PhD dissertation, University of California, Berkeley.

Chappelle, Wayne, Kent McDonald, Billy Thompson, and Julie Swearingen. 2013. "Prevalence of High Emotional Distress and Symptoms of Post-Traumatic Stress Disorder in US Air Force Active Duty Remotely Piloted Aircraft Operators (2010 USAFSAM Survey Results)," AFRL-SA-WP-TR-2013-0002. Wright-Patterson AFB, OH: Air Force Research Laboratory.

Chappelle, Wayne, Tanya Goodman, Laura Reardon, and William Thompson. 2014. "An Analysis of Post-Traumatic Stress Symptoms in United States Air Force Drone Operators." *Journal of Anxiety Disorders* 28: 480–487.

Citron, Danielle Keats and Frank A. Pasquale, "The Scored Society: Due Process for Automated Predictions," *Washington Law Review* 89, No. 1 (2014): 1–33.

Clanahan, Keric D. 2013. "Wielding a 'Very Long, People Intensive Spear': Inherently Governmental Functions and the Role of Contractors in US Department of Defense Unmanned Aircraft Systems Missions." *The Air Force Law Review* 70 (November): 119–202.

Clark, Logan. 2012. "18X Pilots Learn RPAs First." *Holloman Air Force Base News*. February 9. Accessed March 29, 2017. http://www.holloman.af.mil/News/Features/Display/Article/319148/18x-pilots-learn-rpas-first/.

Cohn, Carol. 1987. "Sex and Death in the Rational World of Defense Intellectuals." *Signs* 12: 687–718.

Crawford, Kate. 2016. "Artificial Intelligence's White Guy Problem." *The New York Times*. June 25. Accessed May 3, 2017. https://www.nytimes.com/2016/06/26/opinion/sunday/artificial-intelligences-

CSIS. 2011. "The National Guard: Security America Can Afford." Proquest transcript. Military Strategy Forum, November 18. Washington, DC: Center for Strategic and International

Studies.

Cullen, Timothy. 2011. “The MQ-9 Reaper Remotely Piloted Aircraft: Humans and Machine in Action (Redacted).” PhD dissertation, MIT.

Curtis, Glenn E. 2007. “Comparison of Pay and Benefits Eligibility for Active-Duty Personnel and National Guard and Reserve Personnel on Active Duty.” Federal Research Division, Library of Congress, Washington, DC. Accessed May 3, 2017. https://www.loc.gov/rr/frd/pdf-files/CNGR_Comparison-Pay-Benefits.pdf

Durkheim, Emile. 1997. *The Division of Labor in Society*. New York: Free Press.

Ehrhard, Thomas P. 2000. “Unmanned Aerial Vehicles in the United States Armed Services: A Comparative Study of Weapon System Innovation.” PhD dissertation, Johns Hopkins University.

Ekbia, Hamid R. and Bonnie A. Nardi. 2017; Heteromation, and Other Stories of Computing and Capitalism. Cambridge, MA: MIT Press.

Elish, M.C. 2017. “Remote Split: A History of US Drone Operations and the Distributed Labor of War.” *Science, Technology, and Human Values* 42 (6): 1100-1131.

———. 2018. “24/7: US Drone Operations and the Distributed Work of War.” PhD dissertation, Columbia University.

Elish, M.C. and Tim Hwang. 2015. “Praise the Machine! Punish the Human! The contradictory history of accountability in automated aviation.” Intelligence & Autonomy Working Paper, Data & Society Research Institute.

———. 2016. *An AI Pattern Language.* New York: Data & Society Research Institute.

Ely, Robin J., and Debra E. Meyerson. 2010. “An Organizational Approach to Undoing Gender: The Unlikely Case of Offshore Oil Platforms.” *Research in Organizational Behavior* 30: 3–34.

Filteau, Matthew R. 2014. “Who Are Those Guys? Constructing the Oilfield’s New Dominant Masculinity.” *Men and Masculinities* 17(4) (September): 396–416.

Fino, Steven. 2017. *Tiger Check: Automating the US Air Force Fighter Pilot in Air-to-Air Combat, 1950–1980*. Baltimore, MD: Johns Hopkins University Press.

Gell, Alfred. 1998. *Art and Agency: An Anthropological Theory*. Oxford: Oxford University Press.

Gertler, Jeremiah. 2012. “US Unmanned Aerial Systems.” Report CRS R42136. Congressional

Research Service, Washington, DC.

Goodwin, Charles. 1994. “Professional Vision.” *American Anthropologist* 96(3): 606–633.

Gregory, Derek. 2011b. “From a View to a Kill: Drones and Late Modern War.” *Theory, Culture & Society* 28 (7-8): 188–215.

Guerra, Stephen, and Michael McNerney. 2015. *Air National Guard Remotely Piloted Aircraft and Domestic Missions*. Santa Monica, CA: RAND.

Guidi et al. 2015. “Clinician Perceptions of the Effectiveness of an Automated Early Warning and Response System for Sepsis in an Academic Medical Center. *AnnalsATS* 12 (10: 1514-1519.

Higate, Paul. 2012. “‘Cowboys and Professionals’: The Politics of Identity Work in the Private and Military Security Company.” *Millennium - Journal of International Studies* 40(2): 321–341.

Hoagland, Bradley T. 2013. “Manning the Next Unmanned Air Force: Developing RPA Pilots of the Future.” Center for 21st Century Security and Intelligence Report. Brookings Institute, Washington, DC.

Hutchins, Edwin. 1995. *Cognition in the Wild*. Cambridge, MA: MIT Press.

Ingersoll, Geoffrey. 2013. “Viral Photo Sums Up Military’s Feeling About Drone Medals.” *Business Insider*. Accessed May 3, 2017. http://www.businessinsider.com/viral-drone-warfare-medal-graphic-2013-2.

Irani, Lily. 2015. “Justice for ‘Data Janitors.’” *Public Books*. January 15. Accessed May 6, 2017. http://www.publicbooks.org/justice-for-data-janitors/.

Jaffe, Greg. 2010. “Combat Generation: Drone Operators Climb on Winds of Change in the Air Force.” *The Washington Post*. February 28. Accessed April 12, 2017. http://www.washingtonpost.com/wp-dyn/content/article/2010/02/27/AR2010022703754.html.

Jaffer, Jameel. 2016. *The Drone Memos: Targeted Killing, Secrecy, and the Law*. New York: The New Press.

Janowitz, Morris. 1974. *The Professional Soldier: A Social and Political Portrait*. New York: Free Press.

Jones, Meg Leta. 2015. “The Ironies of Automation Law: Tying Policy Knots with Fair Automation Practices and Principles.” *Vand J. Ent & Tech* 18: 77-134.

Kaldor, Mary. 2013. “In Defence of New Wars.” *Stability: International Journal of Security and Development* 2 (1): 4–17.

King, Anthony. 2006. “The Post-Fordist Military.” *Journal of Political and Military Sociology* 34 (2): 359–75.

Kohn, Melvin L. 1996, 2006. *Class and Conformity: A Study in Values*. Homewood, IL: Dorsey Press.

Kohn, Melvin L., and Carmi Schooler. 1983. *Work and Personality: An Inquiry in the Impact of Social Stratification*. Norwood, NJ: Ablex Publishing Corporation.

Kreuzer, Michael P. 2014. “Remotely Piloted Aircraft: Evolution, Diffusion, and the Future of Air Warfare.” PhD dissertation, Princeton University.

Latour, Bruno. 1993 *We Have Never Been Modern*. Cambridge, MA.: Harvard University Press.

Levy, Karen. 2015. “The Contexts of Control: Information, Power, and Truck Driving Work.” *The Information Society* 31:160-174.

Levy, Karen, and Solon Barocas. 2018. “Refractive Surveillance: Monitoring Customers to Manage Workers.” *International Journal of Communication* 12: 1166-1188.

Losey, Stephen. 2016. “Air Force Deployments Fall, but Still Lean Heavily RPA, ISR, Refueling.” *Air Force Times*. March 14. Accessed May 3, 2017. https://www.airforcetimes.com/articles/air-force-deployments-fall-but-still-lean-heavily-on-rpa-isr-refueling.

Mair, Michael, Patrick G. Watson, Chris Elsey, and Paul Vincent Smith. 2012. “War-Making and Sense-Making: Some Technical Reflections on an Instance of ‘friendly Fire.’” *The British Journal of Sociology* 63 (1): 75–96.

Margolis, Jane, and Allan Fisher. 2001. *Unlocking the Clubhouse: Women in Computing*. Cambridge, MA: MIT Press.

Martin, Emily. 1997. “Designing Flexibility: Science and Work in an Age of Flexible Accumulation.” *Science as Culture* 6(3): 327–362.

Marx, Karl. 1990. *Capital, Volume One*. Translated by Ben Fowkes. New York: Penguin.

Matthews, William. 2015. “Fighting From Home.” *National Guard* August: 22-27.

McLuhan, Marshall. [1964] 1994. *Understanding Media: The Extensions of Man*. Cambridge, MA: MIT Press.

Mateescu, Alexandra, Alex Rosenblat, and Julia Ticona. 2018. “Mapping Inequalities Across the

On-demand Economy." Future of Labor working paper. Data & Society Research Institute.

Mindell, David. Mindell, David. 2000. *War, Technology and Experience Aboard the USS Monitor*. Baltimore, MD: Johns Hopkins University Press.

———. 2015. *Our Robots, Ourselves: Robotics and the Myths of Autonomy*. New York:Penguin.

Moran, Michael. 2004. "Too Many Medals?" *NBC News*. February 24. Accessed May 3, 2017. http://www.nbcnews.com/id/4243092/ns/world_news-brave_new_world/t/too-many-medals/.

Murphy, Robin, and James Shields. 2012. "The Role of Autonomy in DoD Systems." Task Force Report. Defense Science Board, Department of Defense. Washington, DC. Accessed May 2, 2017. https://fas.org/irp/agency/dod/dsb/autonomy.pdf

Noble, David. 1984. *Forces of Production: A Social History of Industrial Production.* New York: Knopf.

Otto, Jean L., and Bryant J. Webber. 2013. "Mental Health Diagnoses and Counseling among Pilots of Remotely Piloted Aircraft in the United States Air Force." *MSMR* 20(3): 3–8.

Ouma, Joseph A., Wayne Chappelle, and Amber Salinas. 2011. "Facets of Occupational Burnout Among US Air Force Active Duty and National Guard/Reserve MQ-1 Predator and MQ-9 Reaper Operators." AFRL-SA-WP-TR-2011-0003. Wright-Patterson AFB, OH: Air Force Research Laboratory.

Panetta, Leon E. 2013. "Transcript: Press Briefing by Secretary Panetta from the Pentagon." News transcript. February 13. US Department of Defense News, Washington, DC. Accessed April 12, 2017. http://archive.defense.gov/transcripts/transcript.aspx?transcriptid=5190.

Parasuraman, Raja, Thomas B. Sheridan, and Christopher D. Wickens. 2000. "A Model for Types and Levels of Human Interaction with Automation." *IEEE Transactions on Systems, Man, and Cybernetics* 30 (3): 286–297.

Power, Matthew. 2013. "Confessions of an American Drone Operator." *GQ*. October 23. Accessed May 3, 2017. http://www.gq.com/story/drone-uav-pilot-assassination.

Powers, Benjamin. 2017. "How Intelligent Drones Are Shaping the Future of Warfare." *Rolling Stone*. March 14. Accessed May 3, 2017. http://www.rollingstone.com/culture/features/how-intelligent-drones-are-shaping-the-

future-of-warfare-w471703.

Prentice, Rachel. 2012. *Bodies in Formation: An Ethnography of Anatomy and Surgery Education*. Chapel Hill, NC: Duke University Press.

Rosenblat, Alex and Kneese, Tamara and boyd, danah, Workplace Surveillance (October 8, 2014). Open Society Foundations' Future of Work Commissioned Research Papers 2014. Available at SSRN: https://ssrn.com/abstract=2536605

Rosenblat, Alex, and Luke Stark. 2016. "Algorithmic Labor and Information Asymmetries: A Case Study of Uber's Drivers." *International Journal of Communication* 10(0).

Satia, Priya. 2014. "Drones: A History from the British Middle East." *Humanity: An International Journal of Human Rights, Humanitarianism, and Development* 5 (1): 1–31.

Sennett, Richard and Jonathan Cobb. 1972. *The Hidden Injuries of Class*. New York: Norton.

Shane, Leo III. 2013. "Drone Medal Fails to Take Off ." *Stars and Stripes.* Accessed May 6, 2017. https://www.stripes.com/news/drone-medal-fails-to-take-off-1.259825.

Shane, Scott. 2016. "Drone Strike Statistics Answer Few Questions, and Raise Many." *The New York Times*. July 3. Accessed May 3, 2017. https://www.nytimes.com/2016/07/04/world/middleeast/drone-strike-statistics-answer-few-questions-and-raise-many.html.

Shaw, Ian, and Majed Akhter. 2012. "The Unbearable Humanness of Drone Warfare in FATA, Pakistan." *Antipode* 44 (4): 1490–1509.

Shinkman, Paul D. 2013. "Pentagon Strikes 'Drone Medal.'" *US News & World Report*. April 15. Accessed April 12, 2017. https://www.usnews.com/news/articles/2013/04/15/pentagon-strikes-drone-medal.

Sommerstein, David. 2014. "You Fly over Foreign Lands, Maybe Kill People, Then Drive Home for Dinner." *Public Radio International*. December 12. Accessed May 3, 2017. https://www.pri.org/stories/2014-12-12/you-fly-over-foreign-lands-maybe-kill-people-then-drive-home-dinner.

Spinetta, Lawrence. 2013. "The Glass Ceiling for Remotely Piloted Aircraft." *Air Space Power Journal* 27(4): 101–118.

Stanford University. 2016. "One Hundred Year Study on Artificial Intelligence (AI100)." Accessed May 6, 2017. https://ai100.stanford.edu.

Star, Susan Leigh. 1999. "The Ethnography of Infrastructure." *American Behavioral Scientist* 43

(3): 377–91.

Suchman, Lucy. 2007. *Human-Machine Reconfigurations: Plans and Situated Actions, 2nd Edition*. 2nd ed. New York: Cambridge University Press.

Swarts, Phillip. 2016. "Enlisted RPA Training to Begin in October, Head of AETC Says." *Air Force Times*. Accessed May 26. Accessed May 6, 2017. https://www.airforcetimes.com/articles/enlisted-rpa-training-to-begin-in-october-head-of-aetc-says.

Tahir, Madiha. 2016. "The Ground Was Always in Play." *Public Culture* 29 (1): 5–16.

Taylor, Frederick Winslow. 1998. *The Principles of Scientific Management*. North Chelmsford, MA: Courier Corporation.

USAF. 2014. "RPA Vector: Vision and Enabling Concepts 2013-2038." Washington, DC: Headquarters, United States Air Force.. http://*www.globalsecurity.org/.../usaf-rpa-vector_vision-enabling-concepts_2013-2038.pdf.* Accessed May 16, 2017.

VA. 2017. "What Is a Veteran? The Legal Definition." *VA.ORG*. Accessed May 6, 2017. http://va.org/what-is-a-veteran-the-legal-definition/.

Van Creveld, Martin L. 1985. *Command in War*. Cambridge, MA: Harvard University Press.

Vertesi, Janet. 2015. *Seeing Like a Rover: How Robots, Teams, and Images Craft Knowledge of Mars*. Chicago: University of Chicago Press.

Vallas, Steven Peter. 2012. *Work*. Malden, MA: Polity Press.

Virno, Paolo. 2004. *A Grammar of the Multitude: For an Analysis of Contemporary Forms of Life*. Cambridge, MA: MIT Press.

Weber, Jutta, and Lucy Suchman. 2016. "Human-Machine Autonomies." In *Autonomous Weapons Systems: Law, Ethics, Policy*, edited by Nehal Bhuta, Susanne Beck, Robin Geiss, Hin-Yan Liu, and Clauss Kress. Cambridge, UK: Cambridge University Press: 75–102.

White, Gillian. 2015. "In the Sharing Economy, No One's an Employee." *The Atlantic Monthly June 8*. https://www.theatlantic.com/business/archive/2015/06/in-the-sharing-economy-no-ones-an-employee/395027/. Accessed March 1, 2018.

Yost, Peter. 2013. "Rise of the Drones — NOVA | PBS." Television. Directed by Peter Yost. Boston, MA: WGBH. Accessed May 6, 2017. http://www.pbs.org/wgbh/nova/military/rise-of-the-drones.html.

Zegart, Amy. 2015. “The Coming Revolution of Drone Warfare.” *The Wall Street Journal*. Accessed May 3, 2017. March 18. https://www.wsj.com/articles/amy-zegart-the-coming-revolution-of-drone-warfare-1426720364.

Zuboff, Shoshana. 1988. *In the Age of the Smart Machine: The Future of Work and Power*. New York: Basic Books.