An Exploration of the Nascent AI Race Dynamics Between the United States and China

The Americas

Justin Brown

Abstract: This study examines the ongoing competition between China and the United States (US) within the field of artificial intelligence (AI) development and implementation. It further inspects this competition as a potential site of a developing security dilemma between the two states. While the academic literature surrounding the politics of AI focuses primarily upon the military and economic applications of AI, very few have examined it as a site of great power competition between China and the US. Relying upon a content analysis of speeches, governmental policy, and think tank reports, this study aims to inspect three primary elements of AI competition: military applications, economic applications, and its ethical or regulatory consequences. Upon close examination, this study finds that Sino-US competition over AI does not presently constitute a security dilemma, however the nascency of the field and the likelihood of a near-term offensive advantage suggest that one may still be likely to emerge.

Introduction

Artificial intelligence (AI) is a term used quite often nowadays, from news reports on job automation, to business meetings on Wall Street, and frequently now in popular culture, sci-fi films, and novels. Most individuals seem to have their own understanding of AI, if one at all, and many are based upon misleading images of killer robots, like Terminator's Skynet, or computer programs that can and will do anything they please, escaping our control and relegating us to a subspecies. Even among academics and scientists working directly in the field, there is little agreement upon the future implications of artificial intelligence (Deloitte 2017). Some consider it the harbinger of a fourth industrial revolution, and others consider it humanity's "biggest existential threat". (McFarland 2014). With all these different images and conceptions of AI floating around, it is difficult to pin down what AI truly is, what it does, and how it does. Yes, AI is crucial to the development of new cutting-edge technologies like the self-driving car, but it is also crucial to comparatively mundane programs such as product recommendations on Amazon, music recommendations on Spotify, Google search results, and traffic directions from your car's GPS (Bradley 2018). In order to truly understand a concept as broad, diverse, and challenging as artificial intelligence, it is necessary to first define the term, as well as the more specific parts and systems that underly its capabilities.

Many different definitions of AI have been formulated over the years, but for the purpose of conducting research on the subject, I define artificial intelligence as such: computer systems that utilize machine and/or deep learning to make decisions and perform tasks normally requiring human intelligence, such as, but not limited to, visual perception, speech recognition,

decision-making, and translation between languages (Oxford Dictionary 2019). This is a slight alteration of the definition provided by the English Oxford Living Dictionary, which provided a solid foundation for understanding the term, and required only a bit more clarity and precision.

Artificial intelligence has come a long way from its inception in the early 1950s. Beginning as simple neural networks, today the technology is primarily characterized by machine and deep learning. Machine learning is an area of computer science in which systems are trained to learn, identify patterns, and make decisions, all mostly without human intervention (SAS 2019). Deep learning is its own type of machine learning; however, it has taken the field of AI much further in much less time. With deep learning, humans set basic initial instructions, but from there the computer is trained to learn on its own through processing loads of data and recognizing patterns that allow it to refine its own analysis. This subfield has been characterized by breakthroughs such as speech recognition, natural language processing, image recognition, and recommendation algorithms (SAS 2019). Today, the field of artificial intelligence is moving at a breakneck speed, run by innovative and transformative new technologies, like deep learning, and fueled by incredible amounts of data from everyday consumers and internet-users. These two aspects of AI development – technological innovation and data – are precisely what has made the United States (US) the leader in AI research and development since its inception (Castro, Chivot, and McLaughlin 2019). However, in the past decade a new major player has arrived on the scene, which threatens to overtake the US in a matter of years – China.

In recent years, both the US and China have formally acknowledged the

importance of artificial intelligence to their domestic economies and national securities. The US has released multiple national reports on AI, as well as the National Artificial Intelligence Research and Development Strategic Plan, which lays out the US government's research and development strategies for propelling its AI capabilities forward (Executive Office of the President 2016). This plan, formulated under President Obama, has since been updated by the Trump administration, but remains largely the same (Executive Office of the President 2019). Similarly, the Chinese government has taken a firm stance on their place in the field of artificial intelligence by releasing the New Generation Artificial Intelligence Development Plan in 2017, which clearly states China's goal to become the leading AI power by 2030, surpassing the United States (Creemers, Kania, and Triolo 2017). Xi Jinping has also made it clear that he believes AI development is a national priority for China. (Creemers, Kania, and Triolo 2017). Overall, both countries' rapid progress in the field of AI has been remarkable. However, it has sparked a great deal of cross-Pacific competition. And while this competition appears benign at the moment, there may be good reason to believe that as AI begins to radically reshape our politics and fuel our economies, it may not remain benign indefinitely.

Even though both countries may not intend for the situation to escalate, that is no guarantor of peace, and there exists a robust volume of political theory which suggests otherwise. The 'security dilemma' is a foundational theory of international relations that has been around since the early 1950s and has had a profound effect on the way academics and government leaders alike view the outbreak of conflict. Understood broadly, the theory posits that in a system characterized by anarchy and uncertainty,

"policies which increase one state's security tend to decrease that of others" (Jervis 1978). In other words, when one state builds up its power in its quest for security, other states perceive this as a threat to their own security, prompting them to do the same. This cycle continually repeats in what has been called the "spiral model," until eventually the situation devolves into conflict or other unintended consequences (Jervis 1978). This explanation of the security dilemma is relatively bare, and the concept is elaborated in much more depth within the review of the scholarly literature. However, it is important to briefly introduce the four key dependent variables that define the security dilemma: that both states are security-seeking; that states resort to the accumulation of power or capabilities as a means to defend against uncertainty; the existence of a clearly identifiable action and reaction cycle; and lastly, the offense-defense balance of the situation (Tang 2009). In order for a situation to be clearly and accurately recognized as a security dilemma, it must satisfy these four essential conditions. By applying these conditions and the concept of the security dilemma to the case of Sino-US AI development, I attempt, through my research, to answer the question: Does the Sino-US competition over artificial intelligence development in the 21st century constitute a security dilemma?

Literature Review

As a distinct technology, artificial intelligence (AI) has been in development for almost seven decades, evolving from simple neural networks into modern machine learning, and eventually, the deep learning systems of the present (SAS 2019). Over this time, its potential has prompted plenty of government and industry research (Executive Office of the President 2016). Unfortunately, the vast majority of this research is situated outside of the social sciences and humanities, and research on AI

within the field of international relations is sparse. However, a few key, prominent conversations around AI have emerged within the existing literature.

For as long as we have lived, new and advanced technology has often become a tool for conflict and violence, and artificial intelligence is no different. The military applications for AI, while in their infancy, are presumed to be wide-ranging, from uses in telecommunications, to battlefield strategizing, to programs that control drones and 'killer robots.' Some applications are considered relatively uncontroversial, and are being actively pursued, such as AI simulation tools which would assist in the training of military personnel, without exposure to the battlefield (Grega, Necas, and Sabo 2019). However, the vast majority of potential applications are thought to be more dangerous; lethal autonomous weapons systems are widely considered to be a worst-case scenario for military applications of AI (Johnson 2019). The reason these 'killer robots' are feared by scholars across disciplines is the inherent lack of agency. The use of robotic soldiers with the objective and capability to kill would replace human agency with artificial agency, however, this is a shift to be resisted. Leveringhaus summarizes the argument brilliantly, pointing out that, "We need to leave space in warfare for pity, compassion and empathy, and the ability to put one's gun down; otherwise we truly risk losing humanity in warfare," (2018). The use of autonomous weapons and robotics in warfare is widely denounced for this reason (Coker 2018; Johnson 2019). Cyberwarfare, however, is a completely separate domain of AI military applications. While there are scholars who work to ensure stability in this new realm of warfare (Taddeo 2018), others have accepted its reality and are more concerned with distinguishing and measuring it (Inkster 2017). Finally, there

are those which, having come to terms with AI's inevitable foray into military strategy, seek primarily to regulate and contain its use (Guihot, Matthew, and Suzor 2017; Johnson 2019). Although it has not yet made the military impact many scholars fear, AI has already proven itself to be a disruption in another area: the economy.

Artificial intelligence has already become an economic disruption in the form of automation. In order to understand the scope of the issue, it must first be possible to measure and identify the changes it is having on our economy, prompting brilliant work by scholars at MIT (Frank et al. 2019). Consistent with their work, most scholars agree upon the threat of automation, but the same cannot be said about their recommendations for the future. There are those who argue for a fundamental shift in the present capitalist system, specifically recommending the "free flow" of information, similar to how we currently conceive of goods and services on the free market (Stubbs 2017). Wei and Peters argue for a similar shift, calling the new system, "intelligent capitalism" (2019). Intelligent capitalism claims to spell the end of jobs in manufacturing and services as AI essentially replaces labor. This begs the question however, "What then becomes the role for education?" (Wei and Peters 2019). In his own article, Peters answers the question by stressing the importance of higher education and keeping education costs low in response to a technological revolution that will fundamentally cause an upheaval of the market (2018). Although the majority of scholars are clearly alarmed by the potential effects of AI on the economy, Judy Wajcman seems to be alone in advocating for nuance and patience (2017). While critically examining assertions of mass job loss amid automation, Wajcman provides reason to relax and, like those writing on

military applications of AI, makes the case for human agency over artificial agency.

Questions of agency are central to understanding the debate surrounding the ethics of artificial intelligence, yet another hotbed of scholarly literature. Taddeo and Floridi tackle this debate head-on, identifying the primary topics of inquiry as delegation/responsibility, invisibility/influence, and lastly, translational ethics (2018). Delegating tasks and responsibility to AI can raise issues, like when a program is responsible for harmful consequences, such as COMPAS, "an AI legal system that discriminated against African-American and Hispanic men when making decisions about granting parole" (Taddeo and Floridi 2019). Additionally, the debate gets more sinister when research turns to the political influence these systems can have. Is it ethical for political campaigns, such as the Trump 2016 presidential campaign or the U.K. Leave campaign to use this technology to sway political outcomes? (Kane 2019). Is it ethical for these campaigns, or anyone else, to use AI to produce and disseminate disinformation? (Landon-Murray, Mujkic, and Nussbaum 2019). And finally, what are the moral implications for technologies like these when those affected have no idea that they are being influenced in the first place? (Landon-Murray, Mujkic, and Nussbaum 2019). Taddeo and Floridi correctly foresee these crucial questions, including one that may never have an answer. Thomas Hauer, in discussing moral dilemmas and artificial intelligence, asks "How does AI autonomously reach the 'better of bad solutions' that we humans usually use to justify our choice when we cannot or do not want to make a clear decision?" (2018). To give an example, what should a self-driving car decide to do when tasked with the decision of hitting a child in the road or avoiding the child and crashing, harming the

passenger? These are the translational ethics Taddeo and Floridi refer to and are quite possibly the most important questions being asked throughout the literature on artificial intelligence, largely because we still have no acceptable answer.

Many pundits and scholars alike turn to regulation as an avenue for solving, or avoiding, the ethical dilemmas surrounding AI. Yet how, and from where, that regulation will occur is a fierce debate throughout the academic literature. Some scholars situate that power in the hands of governments, arguing that governments alone have the power, and responsibility, to regulate artificial intelligence within their boundaries (Gaon and Stedman 2019). However, while in general agreement on the 'where,' there are those that doubt the current ability of governments to enact regulation. Considering the disconnect of AI development from the government, and the subsequent transfer of this control to private corporations over the past few decades, others argue that, at this point, the governments of the world have essentially lost the ability to regulate AI, if they haven't given up on it already (Guihot, Matthew, and Suzor 2017). Government regulation is simply too difficult when private industry has taken complete control of the technology and its use. Other scholars are not so pessimistic. Matthijs Maas believes in the concept of innovation-proof governance – a way of regulating AI in which its ability to innovate and develop rapidly isn't a threat to long-term regulation (Maas 2019). Similarly, Allan Dafoe advocates for a comprehensive framework which brings private industry into cooperation with the government, or even multilateral organizations ("Global Politics and the Governance of Artificial Intelligence" 2018). On the international level, there is less hope. Both Maas and Nindler argue that international organizations, such as the UN,

and international law will be simply unable and unequipped to handle the regulatory challenges posed by the development of AI (Maas 2019; Nindler 2019). However, even if the attempted regulation of AI on the world stage is to take place, its success will likely come down to two countries, the United States (US) and China.

The US and China are the world's leaders in artificial intelligence development, as well as two of the most powerful nations on Earth. While not formally engaging in conflict with one another, the two nations have been at odds in multiple geopolitical confrontations in recent years, leading a handful of students and scholars to interpret these situations as security dilemmas (Baohui 2011; Inkster 2013; Tran 2018.) The 'security dilemma' is a term first coined by John Herz (1950), which he posited as an explanation for the origins of interstate conflicts. In his book, *Political Realism and Political Idealism*, he illustrates the concept as such:

> "Politically active groups and individuals are concerned about their security from being attacked, subjected, dominated, or annihilated by other groups and individuals. Because they strive to attain security from such attack, and yet can never feel entirely secure in a world of competing units, they are driven toward acquiring more and more power for themselves, in order to escape the impact of the superior power of others" (Herz 1951, 14).

Assuming the nature of anarchy and insecurity in the international system, this drive for security would inherently threaten the security of others, prompting a response, and ultimately, a spiraling into conflict. As put simply by Robert Jervis, "policies which increase one state's security tend to decrease that of others" (Jervis 1978). Jervis' own

work was heavily influenced by Herz, and he endeavored to expand the theory by introducing the notions of offense-defense balance and offense-defense distinguishability (1976; 1978). Offense-defense theory, as formulated by Jervis, states that when geographic and technological conditions favor defensive posture, the security dilemma is 'ameliorated,' however, an offensive advantage would have the opposite effect (1978). Jervis also notes the importance in states' abilities to accurately distinguish this balance. In conjunction with the security dilemma, this theory is crucial to the foundations of both defensive realism, championed by Kenneth Waltz (1979), and offensive realism, spearheaded by John Mearsheimer (2001). Despite being a foundational piece of international relations theory over the past couple decades, the security dilemma has attracted a fair amount of criticism. Charles Glaser distills this criticism into three basic critiques: that 'greedy' states are really to blame for interstate conflict, that the security dilemma does not actually exist, and that offense-defense theory is fundamentally flawed (1997). Glaser concludes that only the first critique holds any merit. Others tend to question the explanatory power of the theory, considering it has been used primarily as an explanation for just two conflicts: World War I and the Cold War (Jervis 2001; Collins 1997; Kennedy 1980). However, utilizing this concept to explain the evolving relationship between the US and China has become something of a trend in recent years.

Many scholars have characterized Sino-US competition and military posturing in the South China Sea as exemplifying a security dilemma (Liff and Ikenberry 2014; Tran 2018). Although, there are those who disagree with this conceptualization, asserting the lack of Chinese reaction to US

policy (Wuthnow 2019). Additionally, recent developments with US and Chinese military strategies toward space and cyber have also been described as constituting a security dilemma (Baohui 2011; Inkster 2013). While scholars have interpreted events in the South China Sea, the cyber realm, and even developments in the upper atmosphere as budding security dilemmas (Tran 2018; Baohui 2011; Inkster 2013), very few scholars, however, have yet to situate the conversation of artificial intelligence development within this framework (Dafoe 2018). And this is a crucial deficiency. There is no debate that China and the US are leagues ahead of the rest of the world in developing and implementing artificial intelligence technology, and both governments have released ambitious plans in recent years with common goals of being the world leader in this field (Creemers, Kania, and Triolo 2017; Executive Office of the President 2019). With scholars and governments in agreement that AI has the potential to be a powerful force for change in military, economic, and social realms, is Sino-US competition at risk of developing into what Jervis described as "spirals of arms races and hostility"? (1978). Security dilemma theory, while primarily considered an explanatory model for interstate conflict, can also provide insight into how rational actors might *avoid* conflict altogether. Therefore, the security dilemma framework may provide an important lens for those in the Chinese and US governments who wish to see the development of artificial intelligence as a force for good, and for peace.

Artificial intelligence development has spurred major conversations within the academic literature regarding military applications, economic disruption, ethical dilemmas, regulatory challenges, and Sino-US competition. Separately, Sino-US competition in different regions of the world

have driven the conversation on a possible security dilemma between the two states. However, the two conversations up until this point have remained separate. There is a profound lack of research involving AI development in the US and China and how that competition does, or does not, fit into the model of security dilemmas between states, and therefore, the goal of my research is to fill this gap in the literature.

Methodology

In order to fill this gap in the scholarly literature, it is necessary to first formulate and elaborate upon the methodology the primary analysis follows, from which I attempt to answer the central question at issue: Does the Sino-US competition over artificial intelligence development in the 21st century constitute a security dilemma? In order to sufficiently and accurately answer a question of this breadth and complexity, I first engage in a discussion of the primary elements of AI featured throughout the analysis, then my initial working hypotheses, and finally the variables utilized to test the security dilemma and how they are measured and determined. After the organization and design of the analysis is adequately clear, I move forward to the analysis itself and the conclusions drawn from it.

Throughout the course of this paper, the principal case being examined is the general competition taking place between China and the United States in the field of artificial intelligence research, development, and implementation. As one of the most cutting-edge technologies presently being developed in laboratories and universities across the world, AI promises to hold great potential, and has even been compared to the invention of electricity in that it may one day transform every industry and facet of both our private and public lives (Lynch 2017). Furthermore, looking at AI from an international perspective, this transformative

power will not only be harnessed by businesses and corporations, but by states, which are already applying AI to the task of strengthening their relative military and economic power on the world stage (Grega, Sabo, and Necas 2019; Frank et al. 2019). Therefore, it is surely reasonable to consider how this newfound 'power' may be harnessed by the present-day great powers, such as the two world-leaders in AI development – China and the US – and what competition between the two would likely entail (Shan 2019). Similarly, the last instance in which two great powers competed to harness the power of a new, potentially transformative technology ultimately resulted in the Cold War between the Soviet Union and the US, in which an arms race contributed to a precarious and escalating security dilemma that threatened the whole globe (Jervis 2001). These two comparisons – of AI to electricity and of Sino-US opposition to the Cold War – are what ultimately led me to investigate Sino-US competition over AI as a potential security dilemma, and are why this developing competition is the overarching, predominate case being studied. However, considering the scope and breadth of the subject, it is useful to divide this case into several specific elements which warrant further analysis and discussion.

Based upon the core conversations discussed within the review of the literature surrounding artificial intelligence, AI competition between China and the US will be broken down into three particular components: military power, economic power, and ethical and regulatory consequences. Each component is critical to understanding the overall picture of Sino-US AI competition. In a typical security dilemma, states act to preserve their own security by increasing their power, which is primarily understood in terms of military power (Jervis 1978). For most of human

history, the ability to wage war and conquer others was the defining characteristic of a state's power, making formal military power essential for securing one's borders. However, in recent centuries, aided by a number of diverse factors, the economies of states have also become critical to concepts such as national security and international status. The two largest economies in the world are those of China and the United States, giving both countries incredible power in a globalized market and sparking competition in the form of tariffs and trade wars (Shan 2019). Finally, the dilemmas involving the ethics and regulation of AI are not issues with consequences for the power and security of either state. Instead, these dilemmas begin to bare consequences in the event that one state achieves clear, and irreversible, primacy in the field of artificial intelligence. The state which reaches this point will likely attain the power to make key decisions regarding the ethics and regulation of AI, and ultimately the future of the technology altogether. For these reasons, the military applications, economic applications, and ethical and regulatory consequences of AI development in China and the US are fundamental to testing the existence of a true security dilemma.

Considering these different components, as well as preliminary research and a review of the literature, I hypothesize that Sino-US competition over AI development in the 21st century *does*, in fact, constitute a security dilemma from both a military and economic approach, however, the ethical and regulatory consequences do not contribute to the existence of the security dilemma.

My reasoning for formulating such a hypothesis is twofold. First, from both military and economic perspectives, AI is posed to result in astronomical gains for those countries who harness its potential. In the economic realm, AI is predicted to add

$15.7 trillion to the global economy by 2030, with the majority of these gains accruing in China and the US (Rao and Verweij 2017). In terms of military power, AI researchers believe the technology has the potential to "transform intelligence gathering, warfighting, and the domain of national security more broadly," making it a valuable resource for militaries across the world (Bowerman 2019). This leads me to believe that AI could spark a "race" between China and the US to harness its full economic and military potential before the other, thereby increasing their relative power on the world stage. Second, there is consensus among AI researchers that an AI "race" between actors would likely lead to a "race to the bottom" in terms of AI safety, as countries work furiously against the clock to reap the benefits first (Dafoe 2018). By directing time and money away from AI safety, the ethical and regulatory dilemmas associated with AI safety are more likely to be ignored and thus contribute little to a potential security dilemma.

In formulating a preliminary hypothesis for the question at hand, it was necessary to examine the variables that define any potential security dilemma. As previously described in the introduction to this essay, the four key dependent variables that define the security dilemma are that both states are security-seeking; that states resort to the accumulation of power or capabilities as a means to defend against uncertainty; the existence of a clearly identifiable action and reaction cycle; and lastly, the offense-defense balance of the situation. For any element to constitute a security dilemma, it must satisfy all four variables.

Considering the broad literature surrounding security dilemma theory in the field of international relations, it was initially a challenge to define and operationalize its underlying variables. The

four variables aforementioned are derived from Tang's "The Security Dilemma: A Conceptual Analysis," (2009). Tang does an excellent job of building upon the work of Butterfield, Herz, and Jervis – three of the most influential authors in security dilemma theory – in order to rigorously define the concept and its underlying conditions. He then defines its "eight major aspects" of which I have chosen to focus on four (Tang 2009). I refrain from interrogating preliminary conditions, such as anarchy and uncertainty, for the sake of brevity and clarity, as well as because these are generally-agreed-upon characteristics of the international political community. Furthermore, I refrain from interrogating Tang's final conditions, such as war or aggression, as they are yet to be determined in this particular case (Tang 2009). Tang's four remaining variables, however, serve as critical signifiers of an ongoing security dilemma.

The first dependent variable is arguably the most important of them all. For a security dilemma to be present, both states involved must be considered to be 'security-seeking.' By definition, the security dilemma is "unintentional in origin," (Tang 2009) and it is the result of states merely seeking to protect themselves, instead of deliberately threatening others. Therefore, to satisfy this fundamental condition, each state must sufficiently demonstrate that it is acting primarily in the interest of its own national security and defense, rather than developing capabilities with the ulterior motive of carrying out an attack against its adversary.

Second, it is key that both states resort to the accumulation of power or capabilities as a means to defend against the uncertainty about each other's intentions. Neither state can ever be completely certain of the other's intentions, however, in order to satisfy this condition, it must be clear that

a specific action or policy is enacted with overwhelming consideration for the actions and policies of the other state. For example, if a Chinese leader was to support or defend Chinese strategies and actions by referencing the need to defend itself from possible US attack, competition, or special interests, this would be a prime example of the variable in action.

Third, any potential security dilemma must demonstrate the existence of a clearly identifiable action and reaction cycle. These actions are necessarily those that serve to accumulate power or capabilities, and the action and reaction cycle is a natural progression of the second variable. If an action or policy of a state can be attributed to being heavily influenced or provoked by a specific action or policy of the opposing state, this would be clear evidence of an action and its reaction. In practice, this cycle would likely be composed of a string of three or more actions or policies with clear causal links from one action to the next, generally alternating back and forth between states.

And lastly, the offense-defense balance of the situation is important to identifying a possible security dilemma. First described by Jervis (1978), the offense-defense balance identifies whether it is easier to take territory (in which the offense would have the advantage) or defend it (a defensive advantage). This strategic advantage, whether offensive or defensive, has critical implications for the existence and severity of the security dilemma. As Glaser argues, an offensive advantage increases the likelihood of a spiraling security dilemma, while a defensive advantage has a mitigating effect that is more likely to lessen, or even end, the conditions of the security dilemma (1997). For its part, AI is likely to alter the offense-defense balance of typical nation-state conflict (Dafoe 2018). To identify AI's

potential impact on this balance, I rely primarily upon the insightful and relevant work of Ben Garfinkel and Allan Dafoe of the Future of Humanity Institute (Dafoe and Garfinkel 2018). In analyzing each primary component of AI, this variable is utilized as a final condition to understand the security dilemma in more depth. Rather than simply identifying the presence of a security dilemma, the offense-defense balance can shine light upon the possible likelihood of one developing, if it is not present, and the possible likelihood of one persisting or intensifying, if it is already present.

In order to measure and test each of these dependent variables within the frameworks of each element, every variable is approached with an in-depth content analysis of relevant evidence. The different sources of evidence come in a few different forms. First, the content of speeches and statements given by Chinese/American leaders and governmental officials, whether official memorandums or informal interviews, are analyzed closely. These public statements are a key medium through which states signal their intentions to their citizens and to other states, making them a prime source for observing the intentions of states. Second, a great deal of content analysis is conducted upon official governmental policies and reports released by both the Chinese and American governments. These sources likely represent the most crucial pieces of evidence, given that they clearly outline state intentions, actions, and plans for the future, and will likely form the basis for interrogating the third variable. These policies and reports take the form of national strategies and plans, bureaucratic and agency policies, and specific actions taken under the directive or initiative of higher-level governmental policy. Sino-US AI competition is ultimately waged through these documents and directives. Finally, a fair amount of attention

and analysis is devoted to reports and conclusions made by reputable think tank and civil society organizations, both in the US and China, as well as around the world. Think tank reports provide insight into information, patterns, and trends which states themselves can not, or do not, provide, making them a valuable resource for this analysis. In combination, these three primary forms of evidence provide abundant information and content in order to conduct a comprehensive and sufficient analysis of the key variables in each particular element.

Analysis

Beginning around three years ago, the world's two most powerful nations – China and the United States – finally began to open their eyes to the vast potential of artificial intelligence. The private business sector in both countries had been researching, developing, and implementing new uses of AI across the economy for years. Yet, it was not until a London AI lab, DeepMind, and its AI creation, AlphaGo, defeated Lee Sedol, one of the world's greatest players of the ancient Chinese game Go, in a five-game match that redefined the future of artificial intelligence (Metz 2016). This was the world's "Sputnik moment" for AI and from that point forward, the policymakers and leaders in both China and the US started to see the potential of AI as a transformative technology, with startling implications for the operation and execution of military activities, the growth and expansion of domestic industry, and a myriad of other sectors of political and economic life (Bowerman 2019). Today, both countries have released numerous broad, audacious plans and strategies for the development and implementation of AI. Leaders on both sides of the Pacific are funneling money and governmental support into both public and private AI projects. And most importantly, both countries understand that they are the only two nations at the top

of the ladder, and it has become a race to the top. Broadly speaking, this is the underlying basis for the ongoing Sino-US competition over AI development in the 21st century. However, in order to fully examine the key variables of this analysis, it is necessary to dive far deeper into the particulars and specifics of this competition.

Security-Seekers

The first main variable in defining any potential security dilemma is the condition that both states, in this case China and the US, are security-seeking in nature. This would imply that neither state intends to threaten the other and neither state desires to go to war. To assess whether or not China and the US meet this condition, it is necessary to look at each state's posturing and behavior towards one another. Unlike the next two variables, the analysis of this variable encompasses all three elements together, instead of working through each component individually, because this variable cannot be broken down into the different realms of military, economy, and regulation. Instead, testing this condition is intended to reveal a broad understanding of each state's intentions and combines the three primary components of Sino-US AI competition into one comprehensive analysis in order to identify each state's general posture or behavior towards the other.

In order to identify whether or not both China and the US are inherently security-seeking in nature, I will examine two primary sources of evidence – speeches and statements by leading governmental officials, namely US President Donald Trump and Chinese President Xi Jinping, as well as think tank reports which investigate US-China relations. In public, neither state leader seems to show overt signs of aggression or a willingness to engage in military actions, but instead, have suggested the opposite. In June of 2019, Presidents

Trump and Xi met in Japan to work towards a bilateral consensus on the ongoing trade war between the two nations and both leaders walked away having achieved gains towards alleviating the dispute (Hass 2019). President Trump even remarked that instead of treating China as an adversary, he believed they were "going to be strategic partners," (Hass 2019). For his part, Xi Jinping has been instrumental in organizing trade talks with the US, as well as nuclear talks between the US and North Korea (Jeong-ho 2019). Ultimately, both leaders have shown a willingness to cooperate, especially in order to avoid conflict.

To be sure, it is clear that US-China relations are not truly amicable, and the two countries have engaged in multiple arenas of competition. The US-Chinese trade war and political sparring on geopolitical issues like China's Belt and Road Initiative are just a few examples of heightened tensions and potential sources of conflict between the two (Balin and Hass 2019). However, in these areas, the two countries have also shown subtle inclinations to cooperate for their mutual benefit. On the trade war, both the US and China have demonstrated an overwhelming concern to resolve their differences (Wong and Zheng 2019). In 2015, Presidents Barack Obama and Xi agreed that "government-sponsored, cyber-enabled economic espionage for commercial gain is out of bounds" and pushed other regional bodies to adopt similar stances (Balin and Hass 2019). Additionally, the two nations' technology industries are deeply intertwined, with vast levels of collaboration between researchers, universities, and venture capital firms, especially in the field of AI (Balin and Hass 2019). Ultimately, the two nations show no evidence of outright aggression or desire for military confrontation. Instead, the evidence suggests it is more accurate that although the United States and China are engaged in fierce

competition across a number of arenas, both countries are also "navigating the frontier of innovation simultaneously" (Balin and Hass 2019). While it is obvious that the two states are not close allies, they are also not at the brink of war, and both have displayed a desire to avoid conflict through the utilization of diplomatic channels and bilateral agreements. Both China and the US satisfy the condition of being 'security-seeking' in nature, and therefore, they fulfill the first key variable of any potential security dilemma.

Uncertainty

The next dependent variable that requires testing is that both states resort to the accumulation of power or capabilities as a means to defend against the uncertainty about each other's intentions. In order to analyze and investigate this condition, I first analyze evidence pertaining to the military applications of AI, before moving on to the economic applications, and lastly the ethical and regulatory consequences.

Both China and the US have laid out broad, comprehensive plans for future AI development which heavily feature notions of national security and the military. On the Chinese side, this is exemplified by its New Generation Artificial Intelligence Development Plan. In the US, this is illustrated by the Department of Defense's Artificial Intelligence Strategy. Do these government policies sufficiently suggest that both states are resorting to accumulating AI military capabilities as a means to defend against the uncertainty of each other's intentions? Upon thorough review, it is clear that they do in fact support this condition. First, China's New Generation Artificial Intelligence Development Plan specifically notes that other advanced nations across the world were turning to AI as a means to "enhance national competitiveness and safeguard national security" (State Council

2017). It mentions that this newfound international competition over AI also poses risks for its own national security, and the need to "support national security" features heavily throughout the document, most notably identified as one of the principle goals of the overall plan (State Council 2017). Essentially, China admits that it is uncertain how other countries are leveraging AI, leading it to strongly believe that it must do the same. On the other side, the US takes a very similar stance in the Department of Defense's Artificial Intelligence Strategy. In its introduction, it clearly states that "Other nations, particularly China and Russia, are making significant investments in AI for military purposes," (US Department of Defense 2019). Unlike China, the US directly mentions its cross-Pacific competitor, noting that its use of AI for military purposes is a threat to US "military advantage," (US Department of Defense 2019). The policy does not go further into the threats China poses, but its message is clear. Together, these government policies certainly suggest that both states are resorting to accumulating AI military capabilities as a means to defend against the uncertainty of how the other will utilize and implement AI, and of what the geopolitical effects will be.

From an economic perspective, the question is equally important. In order to understand China's quest for economic dominance, one must focus on the two leading governmental policies China has released in recent years: the New Generation Artificial Intelligence Development Plan and Made in China 2025. China has openly recognized that AI "has become a new important economic growth point" (State Council 2017) and by most calculations, China's economy has the most to gain from AI growth worldwide: a potential 26% increase in total GDP (Ding 2018). Understanding this, China intends to attain a

first-mover advantage and become the most advanced center of AI innovation globally by 2030 (Creemers, Kania, and Triolo 2017). Both plans clearly articulate China's ambition to outperform all other competitors looking to capitalize on the global boom in AI industry growth and take the top spot as the world's largest economy. This necessarily implies surpassing the economic supremacy of the US. For its part, the US recognizes China's ambitions and sees them as a threat to its own supremacy, inspiring its own 'American AI Initiative' in 2019. Its fifth, and final, guiding principle is a direct response to China's potential challenge: protecting US technological advantage in AI (Future of Life Institute 2019). Some scholars even go so far as to suggest that the fear of China leveraging its unrivaled market power to extract "technical competence" and cutting-edge AI research from Western firms was arguably the impetus for the US-Chinese trade war (Dafoe 2018; Cai 2018). Considering the whole picture of Sino-US policy initiatives, the evidence suggests that, like military power, economic power is also a realm in which both China and the US are resorting to the accumulation of AI capabilities as a means to defend against the uncertainty about each other's intentions.

Lastly, the third element through which the second variable can be examined is that of ethical and regulatory consequences. Unlike the cases of military and economic applications, this component presents a unique challenge to both China and the US in that global leaders in AI development and implementation will find themselves in a position to set norms and standards for its use. This is an attractive position for both countries, but both states also fear what standards and norms the other may institute if it achieves supremacy. In the New Generation Artificial Intelligence Development Plan, the Chinese State Council affirms these fears by noting the

inherent uncertainty in how AI will be regulated and governed globally (2017). Furthermore, in June 2019, China's New Generation AI Governance Expert Committee released their own principles for AI governance, and the US has begun to do the same (Future of Life Institute 2019). The aforementioned American AI Initiative sets its own guiding principles for global governance of AI development, specifically on technical standards (Future of Life Institute 2019). However, the most fearful approach to AI regulation comes from the Department of Defense's Artificial Intelligence Strategy. Similar to its remarks on military applications, the report warns that Chinese investments into AI could "erode…and destabilize the free and open international order," (2019). The US Department of Defense, therefore, makes it clear that the uncertainty of how China would develop and implement global regulations surrounding technical standards and ethical practices is considered a threat by the American government. Its response? – to assume the role of world leader in AI in order to set its own standards and regulations. Thus, this evidence supports the fulfillment of the second variable in the ethical and regulatory consequences surrounding AI. Altogether, the second variable was confirmed across all three primary components of Sino-US AI competition.

4.3 Action-Reaction Cycle

The third variable to be examined is the existence of a clearly identifiable action and reaction cycle. The most viable sources of evidence to analyze a possible cycle of 'actions' are US and Chinese policy reports, which span the three primary components of AI competition – military power, economic power, and ethical and regulatory consequences. These reports and whitepapers form the bulk of governmental

actions and directives on AI, largely because implementation and development are still primarily taking place within the private sector at present. In order to adequately confirm the existence of an action and reaction cycle between the US and China on AI, it will be necessary to observe a longstanding and ongoing pattern of state actions on AI, wherein the likely impetus and driving force behind said actions is the behavior of the adversarial state.

The United States was the first of the two countries to begin focusing directly upon the development and implementation of artificial intelligence from a governmental level. US artificial intelligence policy effectively began with the Department of Defense's "Third Offset" strategy in 2014, which looked towards utilizing "next-generation technologies" in order to "assure US military superiority" over other countries (Pellerin 2016). This strategy was followed closely by the Chinese military establishment, which responded not long after by revising its own approach to modernizing its military through increased investment into China's nascent AI research industry (Ding 2018). However, it was not until late 2016, under the directive of the Obama administration, that the US finally began heavily investing in the development of its national AI policy.

In coordination with the White House Office of Science and Technology Policy (OSTP) the Obama administration organized a series of workshops on AI, leading to the release of a flurry of globally influential reports: "Preparing for the Future of Artificial Intelligence," "The National Artificial Intelligence Research and Development Strategic Plan," and "Artificial Intelligence, Automation, and the Economy" (Future of Life Institute 2019; Ding 2018). Among many national governments, the Chinese government in particular seemed to take careful notice. Just months after, in July

of 2017, the State Council of China released its landmark "New Generation Artificial Intelligence Development Plan" (Future of Life Institute 2019). The policy, which outlined China's ambitions to strengthen its domestic AI industry and surpass the US as the leading power in AI by 2030 (State Council 2017), was a direct response to the White House's aforementioned reports (Ding 2018). If the timing is not sufficient evidence, many analysts have also noted a myriad of similarities between China's plan and the US's reports, suggesting that "the drafters of China's AI plan were closely familiar with the previous U.S. administration's policy statements" (Ding 2018). Up until this point, all evidence seems to suggest a developing action and reaction cycle, with the US leading the conversation around AI and China responding in turn to implement similar strategies and policies.

Following the release of its "New Generation Artificial Intelligence Development Plan," in 2017, China continued to release a torrent of governmental policy dedicated to AI. In November of 2017, the Chinese government established an AI Strategy Advisory Committee, as well as an AI Industry Development Alliance (Future of Life Institute 2019). Additional updates and revisions were made to existing governmental plans for the future, such as China's "Three-Year Action Plan for Promoting Development of a New Generation Artificial Intelligence Industry," which was released in 2018 (Kania, Triolo, and Webster 2018). However, in the US, these actions and policies were largely met with no response. Finally, the Trump administration made its first major move on AI with the American AI Initiative, which President Trump launched with an Executive Order in February of 2019 (Future

of Life Institute 2019). Prior to launching this initiative, the only prominent act of the Trump administration in regard to AI was a May 2018 "Summit on Artificial Intelligence for American Industry" (Simonite 2019). From the beginning of his presidential administration in 2017, Trump and the US had fallen behind China with regard to AI policy, and most of China's policies, strategies, and actions went largely unnoticed within the higher echelons of the administration.

Upon consideration of the actions of both the US and China on AI policy and strategy from 2014 to the present, there are a few conclusions to be made. First, beginning in 2014 with the Department of Defense's "Third Offset" strategy, and until China's release of the "New Generation Artificial Intelligence Development Plan" in July of 2017, the actions of both China and the US seemed to indicate the emergence of a clearly identifiable action and reaction cycle. However, upon the election of President Trump, US policy and strategy on AI stalled until recently, finally regaining traction with the American AI Initiative in February of 2019. This lack of action on the part of the US for this period effectively put an end to the developing action and reaction cycle. Still, there are indications that seem to suggest this cycle may be developing once more. In June of 2019, China's New Generation AI Governance Expert Committee released its own principles of AI governance for the future (Future of Life Institute), which may have been a response to the US American AI Initiative. However, this hardly constitutes confirmation of an action and reaction cycle at the present moment. Ultimately, the evidence suggests that a clearly identifiable action and reaction cycle is not present, thereby failing to satisfy the third key variable of a security dilemma. This evidence may suggest, however, that this is the case due to the comparatively

short amount of time from initial AI policy formulation to the present, and it is possible that with more time and opportunity for respective governments to act, a cycle may begin to arise.

Offense-Defense Balance

The fourth, and final, variable requiring analysis is that of the offense-defense balance in Sino-US AI competition. Unlike the preceding three variables, the offense-defense balance is better suited to a comprehensive analysis of only the military applications of AI, due to its focus on states' abilities to attack, and inflict damage and harm upon, one another. As a result, the economic applications and ethical and regulatory consequences are not examined as part of this final analysis. Broadly defined, the offense-defense balance "refers to the relative ease of carrying out and defending against attacks" (Dafoe and Garfinkel 2018). To evaluate how developments in AI influence this ability to attack and defend in typical, present-day interstate conflict, I rely heavily upon the relevant findings of Garfinkel and Dafoe, as well as the general military capabilities of artificial intelligence technologies.

The military application of AI manifests as lethal autonomous weapon systems, drone swarms, and advanced training techniques which improve the lethality and safety of troops on the ground (Gronlund 2019; Dafoe and Garfinkel 2018). These applications serve primarily to inflict harm upon adversaries, while incentivizing speed and accuracy over safety, with no discernible defense yet available (Gronlund 2019). The US and China have already begun development of lethal autonomous weapons and drone swarms, and the presence of this technology in both countries has no bearing on the ability of the defending state to repel such attacks. However, the ability of both states to harness and deploy such weapons systems

could plausibly act as a deterrent to conflict. Aside from physical invasions, cyberwarfare presents an additional realm where conflict could take form in the near future, heavily influenced by applications of AI (Dafoe and Garfinkel 2018).

In cyberspace, an attack is "an attempt to exploit another actor's computer system" (Dafoe and Garfinkel 2018). These attacks make use of software vulnerabilities in vital networks and systems belonging to national governments and can be used for "stealing confidential information, disrupting the availability of a service, or even damaging connected physical objects and infrastructure" (Dafoe and Garfinkel 2018). Such exploitations of weaknesses can be near impossible to defend against once discovered if their existence remains unknown to the vulnerable actor. The American/Israeli cyberattack on the Iranian Natanz nuclear facility, known as Stuxnet, is one devastating and impactful example of such an attack (Zetter 2014). Along with the more physical military applications of AI, cyberwarfare presents another shift in interstate conflict that could potentially contribute to a shift in the offense-defense balance at hand.

In their 2018 study, "How Does the Offense-Defense Balance Scale?" Dafoe and Garfinkel rigorously examine the question of how developments and progress in artificial intelligence technologies will likely influence the offense-defense balance of interstate conflict. Analyzing similar evidence and applications, the pair make a handful of important conclusions regarding this key variable of the security dilemma. Consistent with the prior discussion of military applications, they find that progress in AI increases the number of "weapons platforms" available for actors to deploy against adversaries, as well as the number of "software vulnerabilities" open to exploitation (Dafoe and Garfinkel 2018).

Additionally, they find that increasing investments in these areas significantly impacts long-term estimates of the offense-defense balance, relative to the near-term (Dafoe and Garfinkel 2018). Ultimately, the pair concludes that these factors "will tend to benefit attackers up until some point where they become large enough to benefit defenders" (Dafoe and Garfinkel 2018). Essentially, their research supports the conclusion that developments in AI technology will shift the balance towards an offensive advantage in the near-term, and towards a defensive advantage in the long-term.

Discussion of Hypothesis

Prior to an analysis of the four dependent variables with regards to the three primary elements, I hypothesized that Sino-US competition over AI development in the 21st century does constitute a security dilemma from both a military and economic approach, however, the ethical and regulatory consequences do not contribute to the existence of the security dilemma. Upon a complete analysis of the four dependent variables, the evidence does not support my initial hypothesis. While the first and second variables were satisfied upon close analysis, examination of the third variable suggests that there is no clearly identifiable action and reaction cycle taking place within the Sino-US competition over AI development. This represents a major challenge to a core condition of the security dilemma and suggests that a security dilemma is, in fact, not currently present. With regards to the fourth variable, however, the existence of a near-term shift towards an offensive advantage suggests an increased likelihood of one developing in the near future. To conclude the analysis and answer the initial research question: Upon closer examination and analysis, Sino-US competition over AI development does not constitute a security dilemma with regards to its military

applications, economic applications, or ethical and regulatory consequences.

Conclusion

There is no doubt that the underlying situation upon which this study was based – Sino-US competition over AI development – exists at present and has real implications for policymakers in China, the US, and the rest of the world. While this competition may not rise to the level of a security dilemma, there are still plenty of significant lessons and warnings contained throughout these pages. First, the security dilemma is an inherently unstable, dangerous situation, characterized by uncertainty, miscalculations, and inevitable struggles for power. This evaluation of the Sino-US AI competition is in opposition to many alarmist views which compare the situation to an 'arms race,' akin to the Cold War and nuclear weapons proliferation. Personally, I agree more with the analogy of AI to electricity – a transformative technology with seemingly endless applications across the whole breadth of political, economic, and social sectors of human life. Electricity has been harnessed to achieve incredible leaps forward for mankind, while it has also come with its share of unintended consequences. Furthermore, the evidence suggests that although the situation does not rise to the level of a full-blown security dilemma, both China and the US are engaged in a fierce competition to reap the potential gains of AI, which may serve to eventually spark a true security dilemma. Additionally, as the economic and technical gains from AI development begin to accumulate, a 'race to the top' in capability and market saturation could spark a 'race to the bottom' in AI safety and ethics, the implications of which could be catastrophic. Policymakers in the US and China would do well to understand the possible political, economic, and ethical implications, but we

should not fear all instances of AI implementation as a rule.

This study suffered from one key shortcoming: the fields of AI politics and AI safety, especially in the broader fields of political science and international relations, are comparatively sparse and barren. Academics and policymakers alike have only just begun to pay close attention to AI policy in the past handful of years, but its importance and potential cannot be understated. Further research, analysis, and framework conceptualization surrounding artificial intelligence is therefore necessary in the field of international relations.

The implementation of AI poses multiple risks further down the line in the future, such as massive job loss due to automation, advancements in cyberwarfare, and the undermining of free and fair democratic elections. Policymakers must be aware of these risks and understand artificial intelligence well enough to handle and avoid such catastrophic consequences. Still, the future of AI is exciting and promises incredible benefits in healthcare, business, transportation, etc. Future policymakers and leaders, in both the US and China, must be well-equipped to extract the benefits of AI, while still protecting the public from prospective downfalls. To achieve this vision, cooperation, rather than competition, will be crucial. And the lack of a present security dilemma should serve to encourage policymakers in China and the US to cooperate, rather than compete, on the future of artificial intelligence, while the political costs of doing so are still low and collaboration can be more effectively achieved. The findings of this research are extremely relevant now, and will only become more relevant and important with time. It is my hope that in the face of artificial intelligence, our leaders and policymakers can be counted upon to act with intelligence as well.

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