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Escaping the Trap: Adapting the U.S.-China Arms Race to the Dynamics of Artificial Intelligence

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ABSTRACT

The rapid development of artificial intelligence (AI) has become integral to the defense strategies of major military powers, particularly the U.S. and China, heralding a new era of military innovation. This technological advancement has driven both countries to significantly accelerate their development of intelligent weapon systems, fundamentally reshaping strategic capabilities and defense architectures and profoundly affecting Sino-U.S. strategic relations. The U.S. defense policy explicitly identifies China as a strategic competitor, emphasizing the necessity to maintain a leading position in critical and emerging technologies such as AI. Conversely, China views the U.S. advancements in AI weaponry as efforts to contain its rise and destabilize the international strategic balance. This article examines the transformation of the traditional arms race model in the AI era, highlighting how the new features of AI, such as increased information transfer speed and reassessment of cost-benefit analyses, are reshaping military interactions among great powers. The inability to adapt to these changes could entrap the U.S. and China into a new AI arms competition model, leading to a strategic dilemma. The article concludes with strategies for the U.S. and China to break down traditional tactical choices in the arms race and bypass the five mutually reinforcing traps, enabling competition and cooperation to coexist. This approach aims to rebuild strategic stability, minimize the negative impacts of the AI arms race, and maintain regional and global peace and security.

Keywords: AI Arms Race; Strategic Stability; AI Security; Military Innovation; Sino-U.S. Relations

Introduction

With the rapid development of artificial intelligence (AI) technology and its extensive application in military and strategic domains, there has been a recent surge in rhetoric

advocating that major powers, primarily China and the U.S., are on the edge of an AI arms race (AI Now Institute, 2023a). Both academics and policymakers have pointed to increased military expenditures, the development of intelligent strategic weapons, and the challenges in achieving arms control agreements as indicators of a potential new arms race. However, whether China and the U.S. have really entered an AI arms race remains uncertain. Given that AI technology has fundamentally altered the nature of the arms race, it is crucial to consider whether traditional strategic approaches and perspectives might lead China and the U.S. into "traps" in strategic competition.

Therefore, this paper's core research question is to investigate whether there are new adjustments in the arms race model within the context of AI development and analyze how these adjustments will impact China–U.S. relations.

Literature Review

The study of the arms race becomes most active when there are significant changes in international strategic stability and the global security environment. Scientific exploration of the arms race began during the World Wars and flourished during the Cold War between the U.S. and the Soviet Union. In these studies, especially those focusing on bilateral arms interactions, scholars often adopt the analytical perspective of strategic games. In the most classic arms race model, Lewis Fry Richardson focuses on a country's level of armament at a given time (t), incorporating sensitivity to the armament of another country (response coefficient), internal factors, and external threat perceptions as key variables (Richardson, 1960: 61–69). This model shows that a country's strategic decision-making on armaments is essentially reactive to its adversaries, providing a mathematical and abstract foundational model.

Building on Richardson's model, scholars have adjusted this model by considering the game environment and additional variables. According to Kendall D. Moll and colleagues, in the 1980s, post-World War II armament models began to emphasize the adversary's strategy, the rational choice of discrete variables in the environment, subjective and cultural factors, and the interaction between domestic political processes and military strategy (Moll & Luebbert, 1980). However, with increasing interdependence among states and the growing complexity of the international security environment, many scholars have recognized that the complexity and uncertainty in arms race strategies cannot be fully encapsulated in mathematical models (Anderton, 1989). This recognition has led to a shift towards more diverse research perspectives on the arms race.

From the perspective of international strategic security, Buzan (1987) suggests that the arms race is a comprehensive competition between states in weapons and strategic innovation. By increasing armaments, states seek to establish an effective deterrent. However, this pursuit of security often increases the insecurity of other countries, leading to an escalation of the arms race. Buzan and other scholars illustrate that states may trigger and escalate arms races based on the action-reaction logic, potentially leading to pre-emptive overreactions (Rathjens, 1969). In addition to the external environment, factors such as the attitudes of national military departments, perceptions and views of nationals towards rival countries, and the interests of internal political groups also significantly influence a country's arms race dynamics (Glaser, 2000).

In light of the research needs, this article uses several key variables from the existing arms race research to construct a framework for analysis. First, a simple action-reaction analysis approach is insufficient, considering that AI, as an emerging technology, undergoes continuous development and change. Second, since AI is a technology attached to weapons and influences national decision-making and strategic positioning, a more nuanced approach is required (Grand-Clément, 2023). Therefore, this article adopts an interpretative rather than a mathematical, analytical approach to analyze the AI arms race as a long-term interactive relationship influenced by the interplay of capabilities and strategic intentions between countries within the context of the international security environment and technological development processes.

This article focuses on the following two variables in assessing strategic interactions: the "capabilities" are generally determined by the types and quantities of smart weapons developed and held by countries. In contrast, the "intentions" are defined by bilateral threat perceptions and judgments of each other's strategic movements. On the other hand, the international security environment and the dynamics of technological development are factors of uncertainty in bilateral arms interactions, which can impact the strategic decisions of both sides.

The Current State of U.S.–China AI Military Development

For a long time, despite geopolitical disputes in the Asia-Pacific region and the so-called Thucydides Trap (Allison, 2015), the military interactions between China and the U.S. in conventional domains have not posed any significant issue. This is because the strategic concerns of both countries have been largely passive and restrained, preventing an arms race akin to that of the U.S. and the Soviet Union (Wild 2021). However, in new domains such as nuclear technology, space technology, and artificial intelligence, the specter of an arms race has begun to loom over Sino-US strategic

interactions. On one hand, these emerging strategic technologies—nuclear, space, and artificial intelligence—are referred to as force multipliers. They can exponentially enhance a country's military capabilities through small incremental advancements, thus creating greater allure or alertness for nations. On the other hand, the rapid development and proliferation of these new technologies have significantly increased the complexity and unpredictability of the arms race.

Taking the nuclear domain as an example, the advancement of nuclear technology provides countries with powerful strategic deterrence, granting nuclear powers greater influence on the international stage. However, this increased deterrence also comes with higher risks and greater destructive potential. As more countries acquire nuclear capabilities, the risk of global nuclear proliferation has significantly increased, greatly impacting global security dynamics. Artificial intelligence technology, considered the third military technological revolution after gunpowder and nuclear power, is seen as a key factor in future warfare. Even though the characteristics and application scenarios of AI technology are not yet fully apparent, the impact of a major power AI arms race on international security cannot be underestimated. It is essential to conduct a comprehensive analysis of the capabilities, intentions, and external environment of China and the United States in the AI domain to better understand this complex dynamic.

Assessing AI Military Capabilities of China and the U.S.

The decisive empowering role and strategic support of artificial intelligence (AI) technology have prompted major world powers, including China and the U.S., to accelerate their defense innovations and the application of AI technology in the military field. From a macro perspective, global military expenditure has risen for the ninth consecutive year, reaching an all-time high of $244.3 billion (Tian & Lopes da Silva, 2023). Although it is challenging to ascertain the exact amount of investment in developing new intelligent weapons, the trends suggest that China and the U.S. are rapidly advancing.

Regarding new weapons output, early statistics from the Stockholm International Peace Research Institute (SIPRI) indicate that the United States and China ranked first and fourth in developing new intelligent weapons (SIPRI, 2017). Moreover, defense innovation strategy documents from both countries highlight significant actions. As early as 2018, the U.S. published the Summary of the 2018 Department of Defense Artificial Intelligence Strategy, which systematically outlines the strategic views on utilizing AI technology to gain military advantages. Subsequent U.S. national security strategies have emphasized the importance of AI and other emerging technologies for

maintaining national security and strategic superiority. Correspondingly, China underscored the concept of "speed up development of intelligent military" in its 19th National Congress report (Xi, 2017), reflecting the high priority placed on AI by both the Party and the State and accelerating its implementation through joint efforts from the defense and industrial sectors.

Furthermore, the active performance of major defense suppliers further evidences the rapid development of AI military applications in both countries. For instance, Lockheed Martin, a leading U.S. arms supplier, reported net sales of $17.2 billion in the first quarter of 2024, a 14% increase from $15.1 billion in the same period of 2023 (Lockheed Martin, 2024). This growth is attributable mainly to the innovative role of its Advanced Development Programs (ADP) organization in AI.

Beyond quantitative analysis, the structure of AI militarization in China and the U.S. also shows a high degree of similarity and alignment. According to the Center for Security and Emerging Technology at Georgetown University (CSET), both countries prioritize autonomous vehicles and intelligence, surveillance, and reconnaissance (ISR) in their AI military contracts (Konaev et al., 2023). Despite some disparities in the number of weapons, both nations possess comprehensive deployment capabilities across air, land, and sea, giving them a strategic advantage over countries with imbalanced structures like Italy (SIPRI, 2017).

Therefore, from the perspective of capabilities, China and the U.S. exhibit a certain level of parity in the utilization of smart weapons and the development of the AI military industry. This capability matching forms the foundational basis for observing interactions between the two countries in the field of artificial intelligence from an arms race perspective.

Identifying U.S. and Chinese Threat Perceptions and Intentions of Each Other's AI Military Strategies

Since the Trump administration, the U.S. has increasingly viewed China as a strategic competitor, expressing significant anxiety about China's development of AI technology in the military domain (AI Now Institute, 2023a). This anxiety is generally based on three factors:

First, U.S. officials and policy researchers interpret China's strategic documents, such as the New Generation Artificial Intelligence Development Plan (AIDP) and the government's five-year economic plan, as indicating a robust commitment to AI

development in defense (Allen, 2023). They conclude that China's rapid advancement in AI could undermine U.S. strategic advantages and threaten its defense innovation.

Secondly, there is anxiety about the differences between China and the U.S. in terms of political institutions and socio-cultural foundations. The U.S. believes that China has a very different foundation for the development of AI compared to the U.S. (Avi-Yonah, 2023). On the one hand, China's Central Government has a strong ability to marshal and coordinate resources (Stokes, 2023). In the field of AI, a highly dual-use technology, China's political system and culture can mobilize more local resources to promote national defense capacity building and cooperate with large technology companies to transition strategic areas, in which they have technological prowess (such as AI surveillance technology), into actual combat (AI Now Institute, 2023b). This potential resource that can be transformed into substantial capability has caused the U.S. to be highly sensitive to China's strategic movements. On the other hand, influenced by the tradition of Manifest Destiny and the doctrine of Democratic Peace Theory, the U.S. has an offensive hypothesis about China's behavioral style in the field of artificial intelligence, a domain where technology and values are highly intertwined (Avi-Yonah, 2023). As a result, the United States believes that China's application of AI may be inconsistent with its values and Western ethical norms. This form of alienation has heightened the its sense of alarm.

Thirdly, the U.S. expresses significant distrust towards China due to anxieties about AI's technological uncertainty and information asymmetry. On the one hand, Washington believes that AI technology may "empower" unresolved conflicts in areas such as cyber security and traditional security, such as commercial espionage, thereby posing a threat to national security (Vicens, 2023). On the other hand, the digitalization and stealth characteristics of AI, coupled with the secretive nature of military systems and the lack of effective information channels between China and the U.S., lead to delayed and incomplete assessments of China's strategic posture. This information asymmetry heightens the risk of erroneous judgments or overreactions based on incomplete data, potentially escalating tensions and contributing to an arms race.

China's strategic perception of the U.S. arises from its concern over the U.S.' pursuit of strategic advantage, its discomfort with U.S. anxieties about China, and its uncertainty regarding technological risks. This perception leads China to closely monitor U.S. strategic moves, not merely viewing the U.S. as a strategic adversary, but believing that U.S. actions significantly impact China's development environment. Consequently, China formulates countermeasures to maintain its security and development pace in these turbulent times. This judgment stems from three sources:

First, based on its observation of the post-war U.S.-dominated international system, China believes that the U.S. pursuit of hegemonic dividends in the new field of AI may lead to serious exclusivity and inequality (Li K., 2020). China perceives the current direction of U.S. development in promoting the militarization of artificial intelligence as dangerous. On the one hand, most U.S. military cooperation in AI is still based on its traditional alliances and value coalitions, limiting technological development to a small circle and promoting small-circle standards beyond global borders (Sun C. & Zhang, 2024). On the other hand, observing recent regional conflicts, such as those in Ukraine and Israel, China believes that the U.S. has not utilized AI military technology in a responsible way, but instead acted as a behind-the-scenes manipulator, threatening geopolitical security and stability (Men & Xu, 2022). Therefore, China argues that AI regulations, especially in the field of military security, must not be dictated solely by the U.S. and the West. From this perspective, China views the U.S. as a competing force in the establishment of rules and mechanisms.

Secondly, China argues that the significant technological disparity in artificial intelligence (AI) between itself and the U.S. demonstrates that the U.S.' actions toward China are, in a certain sense, disproportionate and unjustified. Despite this technological gap, China perceives no structural conflict in AI development between the two countries. Instead, it views the U.S.' competitive stance as detrimental to its national security and developmental goals (Chen & Zhang, 2024; Feng, 2024; Qi, 2024). China contends that various U.S. actions exacerbate the situation rather than mitigate it. These actions include sanctioning Chinese AI companies on national security grounds, tightening restrictions on AI academic exchanges, and blocking the AI industry chain, all of which China believes deepen the risks associated with AI development (Li Z., 2020; Xia, 2024). From China's perspective, these measures do not address the root of the issues but rather intensify them, creating a more precarious environment for both countries. In the military domain, China's concerns are even more pronounced. It believes that the U.S. pursuit of comparative advantage through AI advancements poses direct risks to its own security. More alarmingly, China argues that this competitive mindset exacerbates global security threats associated with AI and autonomous weapons. Such technologies, if not properly regulated, could lead to unintended escalations and broader security dilemmas that affect all of humanity (Liu & Li, 2024; Sun H., 2022). Furthermore, China maintains that the existing gap in AI development and innovation between the two countries should not be a basis for antagonistic policies. Instead, cooperative engagement and mutual understanding are essential to mitigating risks and fostering a stable international environment.

Thirdly, influenced by the traumatic memories from previous eras of significant change in the early 1900s, China believes that without mastering technological capabilities, it will lose its global influence and voice. Additionally, China views the U.S.' actions as an attempt to construct a new colonial system in the digital era. This perspective highlights the importance of strengthening cooperation between China and the global South to jointly promote the establishment of a more inclusive, fair, and reasonable international order (Cai, 2024). China aims to balance the distribution of technological power and ensure that the benefits of AI development are widely shared, thereby promoting stability and fairness in the international system.

Synthesizing the bilateral perception of each other's intentions, several basic judgments can be made about the strategic relationship between China and the U.S. in the field of AI military applications. Firstly, both China and the United States view each other's AI military development strategies as risks and threats to a certain extent. Secondly, this threat perception is influenced by historical and cultural factors, complicating the adjustment of their bilateral strategic relationship. Thirdly, in addition to historical causes, the strategic perceptions of both China and the U.S. are also shaped by structural factors at the international level. This suggests that Sino-U.S. interactions in the military field of AI may have broader and deeper international impacts.

Evaluating Environmental Factors Influencing the U.S.-China AI Arms Race

In addition to examining the capabilities and intentions of the U.S. and China, the AI arms race between these two nations is influenced by various environmental factors. These include other countries' technological advancements and military developments, the international political and security environment, and the frameworks of international law and governance.

First, the U.S. appears to have an external advantage over China in the AI arms race due to its closer relationships in traditional military domains and early AI initiatives. Currently, countries like the United Kingdom, France, Japan, India, Israel, and Australia possess not only exceptional AI capabilities, ranking among the top 15 in the Global AI Index (Cesareo and White, 2023) but also have significant smart weaponry and military capabilities. The U.S., leveraging NATO's AI strategy and the AI deployment within the Quadrilateral Security Dialogue (Quad), holds a marked advantage in technology sharing, intelligence exchange, and military cooperation. The U.S. has also signed AI military cooperation agreements targeting China with India and Australia (X. Liu, 2023; Hunnicutt, 2023). In contrast, while establishing partnerships with countries like Russia and Pakistan, China finds these relationships less binding

and less technologically advanced in AI compared to the U.S.' alliances. Therefore, the U.S. enjoys greater support from an external environment perspective, adding asymmetry to the U.S.-China military interaction.

Secondly, the shifting international political and security environment significantly impacts the AI arms race between the U.S. and China. The current global landscape is marked by instability, exemplified by the Russia-Ukraine conflict and tensions in the Middle East, complicating the global security environment. In response to these international security challenges, the U.S. and China must adjust their strategies and policies to address potential threats. This factor drives both nations to increasingly integrate AI into their military applications to navigate the complex international security situation.

Additionally, the influence of international law and global governance frameworks on the AI arms race cannot be ignored. Existing international laws and governance frameworks, such as the Arms Trade Treaty (ATT) and the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), primarily address conventional weapons and nuclear proliferation, leaving the applicability to AI weapons unclear. The UN General Assembly First Committee has initiated discussions on autonomous weapons within the Convention on Certain Conventional Weapons framework, with over 60 draft proposals currently under consideration. Still, no substantive consensus has been reached yet. This lack of clear external regulatory constraints affects the AI arms interactions between the U.S. and China.

Given these assessments, it appears China and the U.S. are on the verge of an AI arms race. However, when scholars and policy researchers from both countries utilize the arms race framework to structure and analyze bilateral interactions and formulate strategies, they risk becoming constrained by this perspective. This approach may inadvertently reinforce competitive dynamics rather than foster cooperation and mutual understanding. The subsequent section of this paper will analyze this issue in detail, examining the potential traps of the AI arms race and suggesting alternative perspectives that could better serve the interests of both countries and contribute to global stability.

Conventional Strategies in the U.S.–China AI Arms Race

This section analyzes the strategic choices available to China and the U.S. if they pursue an AI arms race using conventional military strategies. By examining the envisioned arms race through the lens of traditional strategic logic, we can identify how each nation

might respond to the other's actions. This analysis will help elucidate the motivations behind their strategic decisions.

When tracing back to the starting point of an arms race, there is a classic definition (Gray, 1971: 40): “Two or more parties perceiving themselves to be in an adversary relationship, who are increasing or improving their armaments at a rapid rate and restructuring their respective military postures with a general attention to the past, current, and anticipated military and political behavior of the other parties”. Countries typically choose to initiate or respond to an arms race for two main reasons: firstly, the positive power factor, where a country aims to suppress competitors that may threaten its dominance in order to gain a power advantage; and secondly, the negative security factor, where a country enhances its armaments based on real and anticipated threats to maintain its own security. According to the previous analysis, the U.S. identifies China's capability development in the military field of artificial intelligence and feels anxious about China as a competitive rival. Similarly, China perceives a security risk from the U.S.' militarization of artificial intelligence. Thus, from the starting point of the arms race, both sides have the potential to increase their military investment further.

When it comes to the arms race, regardless of the analytical perspective, increasing armaments and expanding military spending are often seen as the most rational strategies. For example, when the situation of China and the U.S. is analyzed using the Richardson model, it can be expressed as follows:

The military level of a country over a certain period = Positive External Coefficient · Opponent's Military Level + Negative Internal Coefficient · Own Military Level + Environmental Constant.

In this formula, the Positive External Coefficient represents the positive impact of the opponent's military level on the growth of a country's military. The Negative Internal Coefficient represents the negative impact of a country's own military level on its growth. The Environmental Constant represents the impact of other external factors on the military level.

Based on the previous overview of the situation between China and the United States, in order to ensure their security, gain institutional advantages, and maintain discourse in emerging areas, both China and the United States are likely to have high Positive External Coefficients. Given the current state of their bilateral strategic relationship, and in light of strategic documents and defense inputs, both countries intend to increase administrative efforts to mitigate the negative effects of the Negative Internal Coefficient. As comprehensive powers, both China and the U.S. possess strong

capabilities, suggesting that the Negative Internal Coefficients can be controlled at lower levels in the AI arms race. Additionally, the Environmental Constant values may be higher due to uncertainties in the AI field and the sensitivities of the U.S. to the international strategic environment and of China to the international development environment.

Therefore, according to the analysis of the Richardson model, the strategic choices of both sides are primarily focused on the continuous increase in armaments, maintaining high levels of armament expenditures, and strong external threat perceptions. These strategic choices will likely lead to a sustained arms race where both sides continue to increase military spending and develop and deploy more advanced AI weapon systems to maintain or achieve military superiority.

Specifically, if the parameter configurations of both sides are in stable equilibrium (i.e., the product of the Positive External Coefficients is less than the product of the Negative Internal Coefficients), then after a certain period, the armament levels of both sides will converge to a certain stabilization point, reflecting a high-level equilibrium of armament. However, this equilibrium point may be very high, resulting in sustained high military expenditures and significant resource consumption over the long term. Conversely, if the parameter configurations do not satisfy the stable equilibrium condition (i.e., the product of the Positive External Coefficients is greater than or equal to the product of the Negative Internal Coefficients), the arms race will continue to expand, with the stockpiles of weapons on both sides increasing over time. This scenario can be interpreted as a possible war or a persistently high level of tension, underscoring the risks of unchecked military competition and the potential for escalating conflict.

Beyond the Richardson model, the current situation of China and the U.S. can also be analyzed using a classic game theory model. Assume both sides have two basic strategy choices: increase armament (A) and reduce armament (R). We can simulate the strategic choices of the two countries and their outcomes by constructing the following game matrix:

		The United States	
		A	R
China	A	(High, High)	(Medium, Low)
	R	(Low, Medium)	(Low, Low)

In this game matrix, each value represents the gains of both sides under different combinations of strategies. Obviously, increasing armament (A) is a dominant strategy for both China and the U.S. Due to China's rapid development in AI technology, the U.S. is highly sensitive to China's technological advancements. It is concerned that China's progress in AI armament will weaken its military advantage. Therefore, the United States tends to choose to increase its armaments to maintain and enhance its leadership position in AI technology. This choice allows the U.S. to take the initiative in the AI arms race and avoid being disadvantaged due to technological lag.

Similarly, China recognizes the U.S.' advantage in AI military technology, especially given the U.S.' extensive and in-depth application of AI in the military field, which makes China feel threatened. Consequently, China is also inclined to increase armament and enhance the application of AI technology in its military to counter the strategic pressure from the U.S. (Wagner, 1983). Based on this logic, both sides tend to choose to increase armaments to ensure they do not fall into a competitive disadvantage. This strategic choice has led to a vicious cycle of an arms race, with both sides continuously increasing their military spending and upgrading their military technology to maintain or gain strategic advantages in the competition.

However, according to the security dilemma theory, when one country improves its security by increasing armaments, it often leads to the other country feeling insecure and thus increasing armaments (Waltz, 2010: 186–188). This process of mutual stimulation does not increase the sense of security on either side but rather heightens the risk of conflict. This security dilemma is particularly evident in the U.S.-China AI arms race. Once in a security dilemma, the situation may escalate into conflict, where crises trigger and end in conflict, establishing winners and losers. Alternatively, it could reach a fragile stability through a delicate balance of mutual deterrence, or both sides might seek communication channels to escape this cycle.

Therefore, combining the two types of analytical perspectives mentioned above, China and the U.S. should vigorously promote the military application of AI as a strategy that both sides tend to adopt. As a first step based on this type of thinking, both sides may hope to establish an overwhelming advantage over the other, or to build strategic stability based on deterrence and seek arms control in the game. However, due to the specificity of AI technology, the traditional model of arms growth and game may also change, and if China and the United States still follow the original strategy, it may not achieve the results expected by both sides, the “traps” of which will be specified in the next section.

Fivefold Traps in the U.S.–China AI Arms Race Using Conventional Strategies

In this section, we will explore the fivefold traps that China and the U.S. might encounter if they engage in an AI arms race using conventional strategies. These traps represent significant risks and challenges that could undermine their security and strategic objectives, leading to unintended consequences and escalating tensions. By identifying and understanding these traps, we can better appreciate the complexities and dangers of applying traditional military strategies in the context of rapidly advancing AI technologies.

The First Trap: The External Coefficients Trap

The first trap in the U.S.-China AI arms race can be termed the "External Coefficients Trap," where the parameters representing the sensitivity of each country to the opponent's AI weapons volume in Richardson's model may tend toward two extremes. This trap arises from the unique characteristics of AI military applications.

First, many military applications of AI technology are intangible, digitized, and therefore undetectable. This means that adversaries may find it challenging to estimate a country's true military capability accurately. For instance, the application of AI in cyber and electronic warfare is often covert, and these intangible technological enhancements are difficult to detect through traditional means of arms monitoring. Secondly, AI is not merely a new technological field but a new technological dimension. It can enhance the effectiveness of traditional armaments through an enabling role, significantly improving overall military capabilities even without a substantial increase in the number of weapons. This enabling effect is difficult to quantify and detect, making the traditional quantity of armaments no longer the sole measure of military power. Consequently, while the apparent number of armaments may not increase significantly, the actual military capability can rise dramatically. Moreover, the addition of AI has significantly enhanced support technologies at the periphery of the battlefield, particularly in cognitive warfare. For example, the use of AI for intelligence analysis, battlefield monitoring, and decision support can lead to a substantial increase in the military's overall combat capability and response speed (Fang & Zhong, 2022). However, these support technology enhancements are subtle and increase the difficulty of identifying and estimating an adversary's true military capabilities. As a result, the linear relationship between arms growth and threat perception assumed in traditional models is weakened.

The external coefficients trap makes it difficult for China and the U.S. to obtain accurate intelligence through traditional means of arms surveillance in an AI arms race, thereby influencing strategic decisions. Both countries may respond inadequately, underestimating the true military power of their adversaries, or they may increase unnecessary arms expenditures due to excessive vigilance. This uncertainty amplifies the complexity and unpredictability of the arms race, making it challenging for either side to find a stable balance in arms growth. The external coefficients trap thus reflects the far-reaching impact of modern technology on military competition and underscores the need for new strategies and surveillance methods to adapt to these changes.

The Second Trap: The Internal Coefficients Trap

The second trap can be described as the "Internal Coefficients Trap," where the values representing the negative correlation between each country's weapons stock and their domestic situations in Richardson's model fluctuate significantly, potentially to the point of changing their signs.

Unlike technological breakthroughs in traditional military fields, AI is a dual-use technology with mature development and applications in civilian industries. Consequently, the coefficients, which are traditionally assumed to have negative internal effects, may become low in AI and could even shift to positive values.

On the one hand, many AI products developed for civilian use can be slightly adapted for military applications, drastically reducing the expenditure required for military applications. For example, the U.S. is concerned about China’s application of mature surveillance and perception technologies on the battlefield (Kania, 2017). This dual-use capability significantly impacts the strategic balance (Kania, n.d.). On the other hand, large science and technology enterprises and research institutes in China and the U.S. can provide substantial support to the military sector. They also hope to leverage military technology to enhance the development of civilian and commercial sectors. This strengthened commercial-military interaction can transform internal coefficients that originally had a negative effect into positive ones.

The Internal Coefficients Trap is one of the most apparent traps brought by AI to the armament interactions between China and the U.S. As the negative internal coefficients are drastically reduced or even eliminated, the rate of armament growth in both countries could significantly increase. This shift makes it almost impossible to achieve a state where the product of the positive external coefficients is less than the product of the negative internal coefficients, which is required for stabilization in

traditional models. Furthermore, as the internal coefficients shift to having positive effects, there is increased emphasis on internal commercial competition. This dynamic can externalize the AI arms race into an industrial race (Aldane, 2023), leading both sides to escalate their military expenditures and technological investments into a sustained, high-intensity competitive dynamic.

The Third Trap: The Constant Trap

The third trap can be referred to as the "Constant Trap," which arises due to AI's strong uncertainty and emergent nature. This uncertainty can perturb the constant terms in the model, making them dynamic and unpredictable rather than fixed constants.

In the process of AI development and application, each emergence of new technology and exploration of new application scenarios can significantly alter the constant terms, increasing the instability of the model. For instance, when advancements in large language models and generative AI technologies bring about new changes, the subjective relationships in international security (Gao & Zhang, 2023), the competitive landscape (Routledge, 2023), standards of conduct (Nelson, 2023), and resource allocations (Maatouk et al., 2023) all undergo a series of transformations. This instability makes it challenging for states to predict and plan armament strategies based on traditional models. Frequent technological changes require states to have a higher degree of flexibility and adaptability in resource allocation to cope with the ever-changing technological environment.

As a result, the unpredictability of constants complicates strategic decision-making, as countries can no longer rely on stable, predictable constants to guide their actions. This dynamic nature of AI advancements means that strategic plans must be continuously revised and updated to reflect the latest technological developments. The constant trap highlights the difficulty in maintaining a stable arms race strategy when the underlying technological landscape is in constant flux, necessitating new approaches to strategic planning and resource management to adapt to these rapid changes.

The Fourth Trap: The Complex Logic Trap

The fourth trap can be called the "Complex Logic Trap." In a traditional arms race, the decision-making game between states tends to follow a single logic: if a threat is perceived, it is reacted to. However, in an AI arms race, the logic of state responses may become more complex and multi-layered.

First, in the initial response, a range of uncertainties can arise. Since the actual amount of growth and capability enhancement of smart weapons is difficult to accurately grasp, a country may either underestimate the threat and react sluggishly, or overestimate the threat and overreact. For example, a state may fail to upgrade its armaments in a timely manner because it underestimates its adversary's military advances in AI, or it may excessively increase its armaments due to overestimation, resulting in a waste of resources and strategic miscalculation. Secondly, a state may factor in its adversary's non-military technological capabilities or let its guard down by ignoring this variable. For instance, a country might consider its adversary's civilian advances in artificial intelligence technology as a potential military threat and adjust its armament strategy accordingly. Conversely, ignoring these factors might lead to a relaxation of strategy, giving the adversary an opportunity to enhance its military power.

Due to the uncertainty of this first-order behavior, once adversaries receive the signal, they will not only assess the immediate behavior but also attempt to judge the underlying logic. For example, if the U.S. discovers that China has made significant advances in a particular AI technology, it must assess both the actual impact of this advancement on its military advantage and whether China intends to alter the strategic balance through this advancement. This complex logical trap increases the unpredictability of the arms race and complicates strategic decision-making. States must respond in a more intricate environment, considering both direct military threats and potential technological advances and strategic intentions. Such multilayered logical traps make the arms race more difficult to control and manage, increasing the risk of miscalculation and misinterpretation, which in turn may lead to an unnecessary escalation of the arms race.

The Fifth Trap: The Speed-Up Trap

The fifth trap can be characterized as the "Speed-Up Trap," where AI dramatically increases the speed of situational awareness and decision-making, putting countries at risk of missing key points in the arms race cycle.

In a conventional arms race, after the initial decision by both sides to increase armaments, the strategic relationship is not necessarily destined to move towards unlimited arms buildup and escalating hostility. There are still key points in the cycle where countries can escape the security predicament or establish a new strategic stabilization relationship. However, in the field of artificial intelligence, AI can conduct real-time analysis and big data processing, dramatically increasing the quantity of intelligence and enhancing situational awareness sensitivity. Additionally, AI can

provide instant intelligence analysis and strategic advice, enabling decision-makers to quickly formulate and implement military strategies, thus significantly shortening the time from intelligence collection to decision implementation (Wu, 2019). This combination of high sensitivity and speed can lead to poor decision-making by causing overreactions or misjudgments of adversarial intentions. An excessively fast decision-making process may lack adequate analysis and discussion, increasing the risk of strategic miscalculation. Moreover, in a traditional arms race, states usually have a certain buffer time to assess adversarial actions and engage in communication and negotiation. However, the application of AI technology significantly shortens this buffer time, making states more inclined to take immediate action and reducing the opportunities for resolving conflicts through diplomatic means.

As a result of faster decision-making, states may make frequent adjustments to their military strategies in a short period, making it difficult to find a new strategic balance in the arms race. Traditional periods of détente and renegotiation are compressed, increasing the likelihood of both sides falling into a sustained and escalating arms race. This speed-up trap highlights the challenges of maintaining strategic stability in an AI-enhanced environment, where rapid decision cycles can exacerbate tensions and reduce the chances for peaceful resolution.

The aforementioned fivefold traps not only frequently appear in the U.S.-China AI arms race but also interact and compound each other's effects. The external and internal coefficients trap, together with the Constant Trap, alter the basic strategic interaction model, while the complex logic trap and speed-up trap further intensify the uncertainty and difficulty of achieving balance in the arms race. Given the existence and overlap of these five AI arms race traps (Figure 1), China and the U.S. must exercise extreme caution when adopting the arms race framework to justify their strategic decisions and their strategic relationship with each other.

Once China and the U.S. genuinely adopt the strategic thinking of an arms race, the following consequences may ensue: First, strategic judgments based on inaccurate or misleading information may lead to unnecessary and spurious arms upgrades. Secondly, countries may extend the logic of an arms race into industrial competition to strive for a strategic advantage, resulting in uncontrollability in both traditional and nontraditional domains. Thirdly, once China and the U.S. fully engage in an AI arms race, it will become increasingly difficult to find space for balance and negotiation due to the dual traps of a highly uncertain environment and rapid decision-making.

Reflecting on the three possible outcomes of an arms race, the cost of "establishing an overwhelming advantage over an adversary" would rise dramatically. "Establishing strategic stability based on deterrence in the game" would become more challenging, and the opportunity to "seek arms control" would become fleeting. These are the risks and consequences of the U.S. and China entering an AI arms race. To avoid such a situation, both sides should rethink their strategies and seek new approaches to adjust their strategic relationship. This includes fostering communication, enhancing transparency, and exploring cooperative frameworks that address the unique challenges posed by AI technologies in the military domain.

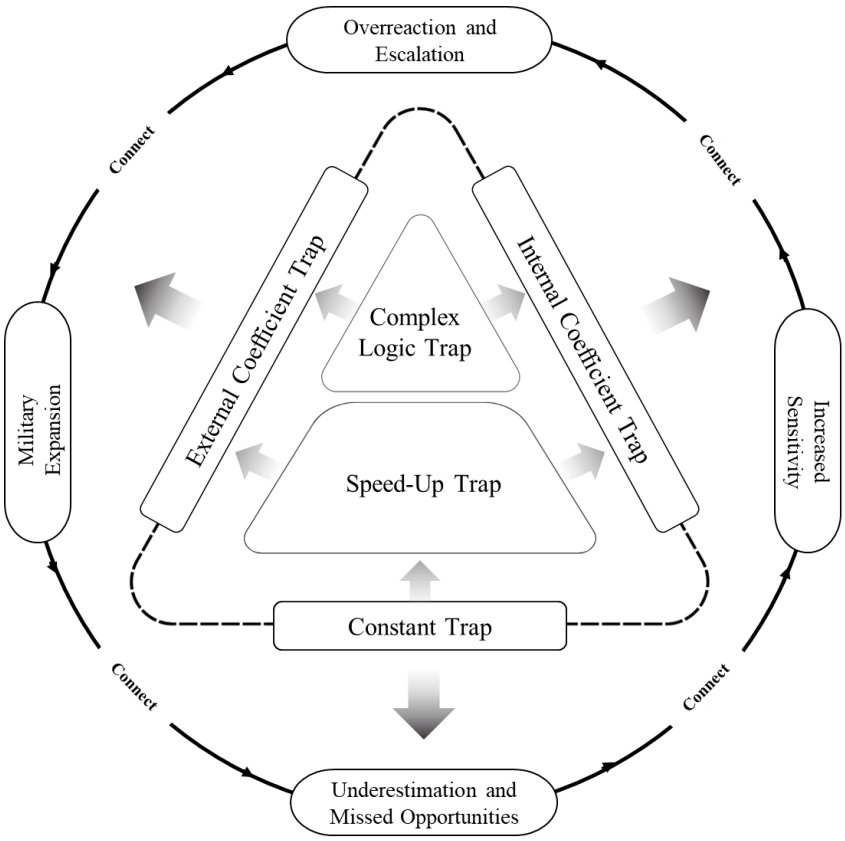

Figure 1: Stacked Traps and Consequences of AI Arms Race

Strategies for Rebuilding U.S.–China Strategic Stability in the AI Era

In the current international environment of intense competition and the rapid development of artificial intelligence, China and the United States need to consider new strategies to balance their relationship under these evolving circumstances. By doing so, they can avoid the risks associated with an AI arms race and promote a stable and cooperative international order.

First, China and the U.S. can consider maintaining a certain degree of transparency about each other's intentions through an in-person form of communication mechanism. The AI arms race itself has inherent logical traps, and the cognitive biases of China and the United States toward each other also deepen the external coefficient traps. This combination of subjective and objective factors makes it difficult for both sides to accurately judge each other's intentions. Additionally, both sides hold pessimistic assumptions about their strategic relationship, observing each other's strategic movements from a highly securitized perspective. For example, the issue of "public attribution" in the cyber era by both China and the U.S. bears deep imprints of politicization and securitization (Levite et al., 2022). This perspective is likely to trigger overreactions and lead to an uncontrollable arms race.

To sidestep this, the U.S. and China need to maintain impersonal channels of communication. In an era of rapidly expanding intelligence information, impersonal communication may not be the quickest or cheapest way to obtain information, but it is the most effective way to explain intentions. High-level military and political dialogues between the United States and China has faced various restrictions in recent years, which is detrimental to the healthy development of their relationship. Enhanced transparency and communication can mitigate misunderstandings and build mutual trust, which is essential for maintaining strategic stability in the AI era.

Secondly, China and the U.S. could consider a dual-track military-industry dialog to develop composite frameworks and agreements. Due to the existence of internal coefficient traps, science and technology companies and research institutes have become important factors in the AI military and security domain. When these non-traditional actors enter the traditional military domain, their actions can have unpredictable negative effects due to the lack of established constraints and standards. Additionally, these actors influence the strategic judgments China and the U.S. make about each other. For example, the U.S. often assumes the worst-case scenario regarding China's AI technological development, whether for military use or not, leading to overestimating China's military expansion rate (Beauchamp-Mustafaga, 2023). Similarly, China has expressed caution about the moves of U.S. tech giants, such as the reaction in China after OpenAI covertly withdrew the clause that its technology is not to be used for war and joined U.S. defense industry partners (Biddle, 2024).

The dual-track military-industry dialogue between China and the U.S. should also include industrial communication to circumvent the internal coefficient trap and the superimposed logic trap. This dual-track dialog should aim to set standards and bottom lines for the behavior of the industrial sector while the strategic sector maintains self-

restraint. By involving military and industrial actors in the conversation, both countries can develop more comprehensive and effective agreements, reducing the risk of misinterpretation and miscalculation in the AI arms race. This approach can help manage the influence of non-traditional actors and ensure that advancements in AI technology contribute to stability rather than exacerbate tensions.

Thirdly, a strategy of rapid situational awareness and de-escalation decision-making can be considered for implementation. The speed trap reveals the challenges posed by AI in increasing the speed of situational awareness and decision-making, which makes it possible for states to miss critical points in the arms race cycle, reducing the likelihood of establishing equilibrium and seeking de-escalation. China and the U.S. could establish a buffer and decision-making assessment mechanism to address this issue. After acquiring information, decision-makers need sufficient time for calm analysis and comprehensive discussion to avoid hasty decisions.

A high-level decision-making committee or crisis management team could be established to evaluate information and formulate reasonable response strategies in emergencies. Additionally, both sides need to extend the decision-making window to allow adequate time for diplomatic negotiations and crisis management. In the current strategic environment, crisis stabilization between China and the U.S. is particularly important.

The advantage of rapid situational awareness lies in the speed of obtaining information, while the speed of decision-making needs to be appropriately slowed down to ensure the accuracy and effectiveness of decisions. Each step in the decision-making process should be well thought out to avoid the escalation of conflict due to hasty actions. Implementing these measures can help manage the speed trap, ensuring rapid situational awareness does not lead to precipitous and potentially dangerous decisions.

Finally, it is recommended that China and the U.S. enhance their cooperation in technology and AI governance to address the environmental constant trap. Unlike the U.S.-Soviet nuclear arms race, which had the Non-Proliferation Treaty (NPT) to strictly control technology transfer, cooperation, and research data sharing, the uncertainty and emergence of AI technology make it insufficient to establish a regulatory framework solely at the bilateral level between China and the U.S. to cope with the international security issues brought about by this technological development. On one hand, new algorithms, hardware advances, and application scenarios can rapidly alter the balance of military capabilities. On the other hand, the current lack of unified AI governance

norms and rules internationally, along with differences in the application and development of AI technology across countries, increases the unpredictability of the technological race and strategic instability.

Therefore, as major powers in the AI domain, China and the U.S. must first cooperate to govern the external environment of AI development and application to bypass the environmental constant trap. This cooperation would make the "constant" in AI development more measurable, predictable, and evaluable. Both nations should actively participate in developing international standards and norms, jointly promoting the application of AI technology in accordance with international law and ethical guidelines. They should collaborate under the global AI governance framework centered on the United Nations to ensure that AI technology progresses in a peaceful, safe, and controllable environment.

Moreover, the two sides should establish a crisis management and collaborative response mechanism to quickly coordinate their responses to emergencies caused by sudden technological changes. This mechanism would enhance their ability to manage unforeseen developments and maintain strategic stability. By working together on AI governance and technology cooperation, China and the U.S. can mitigate the risks associated with the environmental constant trap and contribute to a more stable and secure international order.

Through these measures, China and the U.S. can collaborate in the era of artificial intelligence to transcend the traditional tit-for-tat tactical choices in the arms race. By adopting strategies that enable competition and cooperation to coexist, with clear goals and bottom lines, both nations can bypass the five mutually reinforcing traps in the arms race. This approach will help rebuild strategic stability, minimize the negative impacts of the arms race, and maintain regional and global peace and security. By working together, China and the U.S. can ensure that AI technology is developed and applied to promote mutual understanding and benefit all, thereby contributing to a more stable and secure international order.

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