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Enhancing US-China Strategic Stability in an Era of Strategic Competition

US AND CHINESE PERSPECTIVES

Edited by Patricia M. Kim

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CONFLICT ANALYSIS & PREVENTION

ABOUT THE REPORT

In winter 2020, the United States Institute of Peace convened a series of workshops with US and Chinese security experts to discuss how Washington and Beijing can strengthen strategic stability amid growing strategic competition. This report presents essays by the twelve participants who examine the perception gaps, challenges and opportunities for enhancing stability in the nuclear, missile and missile defense, space, cyber, and artificial intelligence realms.

ABOUT THE EDITOR

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Cover photo: Flags at a US-China bilateral meeting during the G20 summit in Osaka, Japan, in June 2019. (Photo by Erin Schaff/New York Times)

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As strategic competition between the United States and China intensifies, the danger of a US-China military confrontation is no longer a far-fetched scenario. Despite recognition in both capitals of the growing risks of major power conflict, the United States and China have few, if any, effective mechanisms to resolve their differences peacefully. Enhancing strategic stability by lowering the risks of military, and especially nuclear, conflict; managing emerging technologies and new frontiers of conflict such as those in space and cyberspace; and preventing a destabilizing arms race are now more critical than ever to ensure that the United States and China can compete without disastrous consequences.

As the essays in this volume make clear, US-China relations are beset by a profound lack of trust and mutual skepticism of each other's strategic intentions. Stark differences in the two states' nuclear doctrines, policies, and interests in arms control pose significant challenges to pursuing strategic risk reduction. In addition, an action-reaction dynamic is laying the foundation for a dangerous and costly arms race. US-China strategic stability discussions are further complicated by the fact that they are not just bilateral in nature, but also have critical implications for third parties, especially US allies, and are intertwined with other regional challenges. The sharp deterioration in the broader US-China bilateral relationship and disappointment with past bilateral exchanges have impeded meaningful dialogue on security-related issues and diminished the political appetite for cooperative measures.

While each essay in this report advances distinct policy recommendations, the authors broadly recommend that to strengthen strategic stability in the near term, the United States and China should jointly affirm that nuclear war should never be fought and work together to reduce the dangers posed by nuclear weapons; initiate sustained and substantive official bilateral dialogues and parallel track 1.5 efforts to increase mutual understanding and begin exploring risk reduction and arms control measures; establish norms of behavior and transparency measures, especially to govern the use of emerging technologies and to regulate developments in space, cyberspace, and AI; and engage other key states to strengthen global strategic stability.

Secretary of State Antony Blinken and National Security Advisor Jake Sullivan speak with Chinese Communist Party foreign affairs chief Yang Jiechi and Foreign Affairs Minister Wang Yi at US-China talks in Anchorage, Alaska, on March 18, 2021. (Photo by Frederic J. Brown/AP)

Introduction

By Patricia M. Kim

As strategic competition between the United States and China intensifies, the danger of a US-China military confrontation is no longer a far-fetched scenario. Despite recognition in both capitals of the growing risks of major power conflict, the United States and China have few, if any, effective mechanisms to resolve their differences peacefully. Enhancing strategic stability by lowering the risks of military, and especially nuclear, conflict; managing emerging technologies and new frontiers of conflict such as those in space and cyberspace; and preventing a destabilizing arms race are now more critical than ever to ensure that the United States and China can compete without disastrous consequences.

In the winter of 2020, the United States Institute of Peace (USIP) convened a group of twelve leading security experts—six American and six Chinese—to engage in a series of workshops and to write parallel essays on the perception gaps, challenges, and opportunities associated with strengthening US-China strategic stability. The resulting essays are presented in this report.

The first of six sections features companion pieces by Brad Roberts, director of the Center for Global Security Research at the Lawrence Livermore National Laboratory and former US deputy assistant secretary of defense for nuclear and missile defense policy, and Li Bin, professor of international relations at Tsinghua University and a renowned nuclear security expert. Roberts and Li provide broad overviews of US and Chinese conceptions of strategic stability, the

roadblocks the two states have encountered thus far in enhancing bilateral strategic stability, and recommendations for how Washington and Beijing can create momentum to deepen mutual understanding and advance stabilizing measures.

In the sections that follow, five pairs of experts delve deeper into US and Chinese capabilities, the sources of conflict, and the challenges and opportunities for enhancing stability in five specific domains: nuclear forces, conventional missiles and missile defense, outer space, cyberspace, and artificial intelligence.

Patricia M. Kim, senior policy analyst on China at USIP, and Jiang Tianjiao, assistant professor at the Fudan Development Institute, write about the United States' and China's nuclear forces, both of which are undergoing modernization efforts and, in China's case, rapid expansion, raising concerns about the growing salience of nuclear weapons in US-China strategic competition.

Zhao Tong, senior fellow at the Carnegie-Tsinghua Center for Global Policy, and Bruce MacDonald, adjunct professor at the School of Advanced International Studies at Johns Hopkins University and former senior director for science and technology in the Clinton administration's National Security Council, examine the United States' and China's conventional missile and missile defense capabilities, which have long been points of contention in US-China discussions about strategic stability.

Frank Rose, senior fellow for security and strategy at the Brookings Institution and former US assistant secretary of state for arms control, verification, and compliance, and Guo Xiaobing, director of the Center for Arms Control Studies at the China Institutes of Contemporary International Relations, discuss US-China strategic competition in space, where advancements in military space capabilities are increasing the risk of clashes, including ones that could lead to nuclear escalation.

Lyu Jinghua, a former visiting scholar with the Cyber Policy Initiative at the Carnegie Endowment for International Peace and a retired colonel of the Chinese People's Liberation Army, and Adam Segal, Ira A. Lipman chair in emerging technologies and national security and director of the Digital and Cyberspace Policy Program at the Council on Foreign Relations, discuss US-China strategic competition in cyberspace, another growing conflict domain that lacks established rules and norms to constrain behavior, such as cyberattacks on core nuclear systems, that can pose a serious threat to strategic stability.

In the sixth and final section, Qi Haotian, assistant professor in the School of International Studies at Peking University, and Lora Saalman, associate senior fellow at the Stockholm International Peace Research Institute, write about rapid advancements in artificial intelligence (AI) and its incorporation into military capabilities by both the United States and China that have raised concerns about the impact of AI on current and future conflict dynamics.

The juxtaposition of essays written by American and Chinese scholars highlights both the striking differences and the commonalities between US and Chinese assessments of the drivers of instability and which side shoulders greater blame for destabilizing trends in these five domains. The essays also suggest concrete steps that Washington and Beijing can take in the near future to strengthen strategic stability in an era of strategic competition.

KEY OBSERVATIONS

Below is an edited selection of key observations drawn from the essays. It is important to note that the following points are not necessarily unanimously endorsed by all authors. In fact, as demonstrated in their individual contributions, the authors often disagree in their assessments and recommendations. Nevertheless, the following observations repeatedly emerged during the workshops and are widely reflected across the essays in this report.

There is mutual skepticism of strategic intentions and a profound lack of trust between the United States and China, especially as both states modernize (and in China's case expand) their nuclear forces and develop increasingly sophisticated weapons and technologies that impact strategic stability. Many in the US policymaking community believe China is expanding its military capabilities not just for defensive purposes, but in order to ultimately displace the United States from the Indo-Pacific region and reorder that arena in China's favor. This perception has heightened US concerns about China's nuclear modernization drive and fueled skepticism of its nuclear doctrine that is premised on a "no-first-use" policy. Chinese leaders, in contrast, believe the United States is containing China and pursuing "absolute security" at its expense by working to negate its second-strike capability. They also accuse the United States of lowering the threshold for nuclear war, citing as evidence Washington's adoption of new low-yield nuclear weapons and its withdrawal from arms control agreements in recent years.

Stark differences in the United States' and China's nuclear doctrines, strategic perceptions, and interests in arms control pose significant challenges to pursuing strategic risk reduction. Beijing's nuclear strategy relies on opacity and uncertainty to enhance deterrence, whereas Washington's traditional approach toward arms control and risk reduction has been premised on transparency through measures such as data exchanges, monitoring, and on-site inspections. As a result, demands by China for the United States to pledge no first use of nuclear weapons, which Washington has eschewed in consideration of its allies that rely on US extended deterrence guarantees, and Washington's demands for greater transparency into China's nuclear forces and the nuances of its nuclear policies have led to an impasse between the two powers.

An action-reaction dynamic underpins the United States' and China's respective drives to develop cutting-edge military capabilities and is laying the foundation for a destabilizing arms race. China and the United States often cite each other's advancing nuclear and conventional capabilities as necessitating their respective development of increasingly sophisticated conventional and nuclear weapons. Because both sides worry that perceived or real changes in the military balance, and especially in the strategic balance, will embolden the other to engage in riskier actions, they remain reluctant to pursue mutual, let alone unilateral, measures of restraint.

The growing entanglement of conventional and nuclear systems, and the potentially destabilizing impact of emerging cyber and AI capabilities, have increased the risks of nuclear escalation. For example, US experts have long been concerned about China's practice of co-locating its nuclear and non-nuclear missiles given the dangers this practice poses for inadvertent escalation, whereas Chinese experts believe this uncertainty enhances deterrence. Moreover, increasing military activities in cyberspace and outer space, the emergence of AI-supported intelligence, surveillance, and reconnaissance systems, and the potential integration of AI into nuclear command, control, and communications (NC3) systems, have all heightened concerns about accuracy, attribution, and speeding up the of the conflict environment, as well as the general lack of agreed-upon norms of behavior in these emerging domains.

US-China strategic stability discussions are further complicated by the fact that they are not just bilateral in nature, but also have deep strategic implications for third parties, especially US allies, and are intertwined with other regional challenges. For instance, many of the obstacles associated with US-China arms control measures involve the security interests of US allies in the Indo-Pacific region that depend on US extended deterrence guarantees and must deal with the nuclear threat posed by North Korea, in addition to an increasingly assertive and militarily capable China.

The sharp deterioration in the broader US-China bilateral relationship and disappointment with past bilateral efforts have impeded meaningful dialogue on security-related issues and diminished the political appetite for cooperative measures. As many of the authors point out, previous bilateral dialogues at both the track 1 and track 1.5 levels failed to yield much concrete progress in constructing stability-enhancing measures and mechanisms, leading to the suspension of dialogues and the sidelining of arms control and risk reduction efforts in recent years. Moreover, the increasingly competitive nature of the US-China relationship limits the scope of technological and commercial cooperation between the two states.

KEY RECOMMENDATIONS

Despite these grave challenges, both the United States and China share strong mutual interests in steadying the bilateral relationship and strengthening global and regional strategic stability. The following are an edited selection of key recommendations, which, like the key observations, may not be unanimously endorsed by the authors but are supported by many of them.

The United States and China should consider taking the following steps in the near term:

Jointly affirming that a nuclear war should never be fought and to work together to reduce the dangers posed by nuclear weapons. Such an affirmation would symbolize commitment by both major powers to lower the risk of nuclear war, avoid an arms race, and cooperate on strengthening global nonproliferation norms. It could serve as a significant first step in the process of building trust and inspiring cooperation on more far-reaching bilateral and multilateral arms control and risk reduction measures.

Launching sustained and substantive official bilateral dialogues, as well as parallel track 1.5 efforts, to develop a shared understanding of the dangers in the United States' and China's evolving strategic military relationship and explore ways to separately and together reduce those dangers. Without exception, every author in this volume emphasizes the need for the United States and China to engage in dialogues in order to, at a minimum, deepen understanding of each other's strategic intentions, doctrines, and postures; discuss the impact of nuclear modernization and emerging technologies on each side's concerns and interests; and explore arms control, risk reduction, and crisis management mechanisms to prevent unintended military, and especially nuclear, escalation. Many authors also make the case that the strategic stability agenda should be delinked from other bilateral issues and shielded from the vicissitudes of the broader bilateral relationship. And all authors highlight the value of engaging nongovernmental experts at the track 1.5 and track 2 levels to explore innovative arms control frameworks and engineering measures, as well as issues not yet ripe for discussion at the official level.

Establishing norms of behavior and transparency measures, especially to govern the use of emerging technologies such as hypersonic missiles, and to regulate developments in space, cyberspace, and AI that have implications for strategic stability. Rules of behavior should be established to keep sensitive infrastructure, such as core NC3 systems, off-limits to attacks and cyber intrusions to prevent miscalculations and unintended escalation. The two sides should also engage in conversations on the implications of AI for the future of warfare and work toward rules and norms, and eventually binding multilateral agreements, that can enhance strategic stability in an increasingly AI-integrated world.

Engaging other key states to strengthen global strategic stability. The United States and China should pursue dialogue with the other permanent members of the UN Security Council to discuss arms control, global strategic stability, and nonproliferation issues, including cooperating on the nuclear challenges posed by Iran and North Korea. The United States should also

engage in parallel consultations with key allies and partners on potential arms control agreements and on ways in which the United States can enhance strategic stability with China without undermining its extended deterrence commitments to allies. For its part, China should recognize the growing threat perceptions of its neighbors in the Indo-Pacific and consider various reassurance measures and pledges not to use military force to resolve outstanding conflicts in the region—actions that would constitute a critical step toward enhancing strategic stability.

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In conclusion, there is considerable work ahead to strengthen strategic stability between the United States and China. Such efforts will be critical in what is likely to be an extended era of strategic competition. While the challenges are many, the opportunity to make progress is ripe, with the Biden administration expressing its commitment in the March 2021 Interim National Security Strategic Guidance to "re-establish U.S. credibility as a leader of arms control" and to "address the existential threat posed by nuclear weapons" by working to reduce the role of nuclear weapons, pursuing new arms control arrangements, and engaging in meaningful dialogue with China and Russia.[1] In recent months, Chinese officials such as Fu Cong, director general of the Chinese Foreign Ministry's Department of Arms Control, have also expressed support for initiating discussions on cyber, space, and AI capabilities to work toward "legally-binding international instruments or codes of conduct" to "reduce potential risks and challenges that these technologies could bring to international stability and security."[2]

The United States and China should seize this moment to jointly reduce the risk of nuclear war and to strengthen global strategic stability, starting with the resumption of track 1 and 1.5 bilateral and multilateral dialogues, and working toward more ambitious, long-term initiatives such as bilateral and multilateral arms control agreements that can help create a foundation for the United States and China to compete and coexist peacefully in the decades ahead.

Chinese military vehicles carry DF-17 ballistic missiles during a parade in Beijing on October 1, 2019, commemorating the 70th anniversary of the founding of the People's Republic of China. (Photo by Mark Schiefelbein/AP)

Strategic Stability and US-China Relations: A Broad Assessment

As the US-China relationship becomes increasingly characterized by competition and, in some cases, outright confrontation, enhancing strategic stability between the two nuclear-armed states is more critical than ever. Brad Roberts and Li Bin discuss US and Chinese views on what "strategic stability" entails, from the narrower, traditional definition focused on curbing incentives to engage in an arms race and to use nuclear weapons during conflict, to more expansive conceptions that involve decreasing the overall risks of war and enhancing stability in the broader relationship. The authors outline issues that have impeded US-China discussions on strategic stability, including divergent perspectives on the drivers of instability and the entanglement of other regional threats and actors in strategic issues. Roberts and Li both point out that Washington and Beijing must create the political conditions necessary for substantive official and expert-level dialogues. Roberts argues that the two sides should drop unreasonable demands that have hampered dialogues and that US leaders should incentivize Chinese leaders to engage in risk reduction and dialogue by clearly articulating why Beijing's nuclear policies have been less stabilizing than they believe. Li makes the case for unilateral and mutual declarations of nuclear restraint that can help build confidence and create momentum for more stabilizing measures.

US Perspective

By Brad Roberts

STRATEGIC STABILITY IN AN ERA OF STRATEGIC COMPETITION

US-China relations have taken a dramatic turn for the worse over the last decade or so, as the effort to develop win-win strategies for cooperation has faltered on an intensification of competition, the emergence of divergent visions of the needed regional and global orders, and the rising risks of military confrontation. As rivalry intensifies, many new concerns are emerging about the military relationship between the United States and China. In the strategic military dimension of the relationship, each side has concerns about what the other is doing that it deems injurious to strategic stability.

The relationship between two adversarial nuclear-armed states is stable when neither perceives an increasing risk of war or other militarized threats to its interests, an imperative to strike first in time of war, or the possibility of gaining a significant advantage of some kind through quantitative or qualitative changes to the strategic posture. In an era of strategic competition, one or both rivals may fear that the other is putting strategic stability in jeopardy in one or more of these dimensions. Ambiguity about strategic intent, both present and future, amplifies this fear. As risks rise, there is a rising incentive to identify cooperative steps to reduce them. But the political basis of cooperation may not exist if one or both competitors assess that further competition promises significant strategic gain or that increased risk is valuable in inducing caution by the other. If only one competitor seeks to reduce risks, then it may consider taking unilateral steps, although there is no guarantee that its actions will actually have a stabilizing effect. Unilateral efforts may in fact create the impression that the risk-reducing state is too fearful of risk to defend its interests, thereby increasing risk unwittingly.

In the present era of strategic competition, there are additional complexities. One is the multipolar character of the competitive landscape and the fact that the United States has qualitatively different strategic relationships with Russia, China, and North Korea. Actions taken to stabilize one relationship (e.g., to stay ahead of the North Korean missile threat to the US homeland with missile defenses) can perturb the other relationships. Another complexity is the multidomain character of contemporary strategic competition, with nuclear-armed rivals also competing for decisive advantage in cyberspace and outer space.[1]

Long-running exchanges between policy experts and academics in the United States and in China have reinforced the impression that the two communities have very different ideas about strategic stability.[2] This exaggerates the differences. The two communities share the basic concepts of crisis and arms race stability, as set out above. Some observers argue that although the two communities share the "narrow view" of strategic stability based on those concepts, China also has a "broad view," unlike the United States. That broad Chinese view takes into account the nature of the international system and whether or not the main actors coexist in harmony. In fact, the United States has a broad view of its own—of the risks of war, including nuclear war, in a changing international system. But its experts and policy documents do not generally invoke the lexicon of strategic stability to characterize those factors.

ENHANCING STRATEGIC STABILITY: CHALLENGES AND OPPORTUNITIES

The primary challenge to strategic stability is that the two countries do not diagnose the current situation in the same way. From China's perspective, strategic stability has been undermined by US actions but ensured

by China's reactions. From the US perspective, the strategic deterrent relationship has been stable in the past but is now growing less so because of China's actions.

China's views follow from its assessment that US adjustments to its strategic posture aimed at negating the emerging deterrents of "rogue states" through a limited missile defense of the American homeland and a niche prompt strike capability have damaged the credibility of China's nuclear deterrent. Accordingly, China has joined Russia in complaining about the purported American pursuit of "absolute security" (a strategic posture supposedly giving the United States both "freedom to attack" and "freedom from attack"). Their argument is that absolute security would enable the United States to use military force against any power, minor or major, in pursuit of a value-driven foreign policy that aims, among other things, to foment pro-democracy Color Revolutions. China has also joined Russia in throwing up every possible obstacle to the US pursuit of such capabilities and in advancing its own strategic force, nuclear and otherwise, that cannot be easily "negated" by the United States.[3]

US views follow from an assessment that China and Russia have an assured retaliation posture and that American ambitions for missile defense or non-nuclear prompt strike capabilities will not alter this reality. Instead, the United States and its allies worry increasingly that the traditions of nuclear minimalism that governed China's nuclear policy for decades are giving way to something more troubling. For example, a decade or so ago, Beijing decided to address problems with the credibility of China's deterrent by making qualitative improvements to its nuclear forces; today, both qualitative and quantitative adjustments are clearly underway, and possibly also doctrinal adjustments, such as a potential move to "launch on warning" for China's land-based intercontinental ballistic missiles. Moreover, China's growing hostility toward US alliances, assertiveness in the maritime environment, militarization of unsettled disputes, and development of a conventional force posture tailored to the challenges of negating US power projection have all contributed to a rising concern about the prospects for war.[4]

The opportunity to strengthen strategic stability arises from intensifying strategic competition. Competition in the strategic military domain is in fact new. For the last three decades, China competed with the United States in a limited fashion, seeking only to build and field a nuclear force large, diverse, and modern enough to sustain its policy of assured retaliation. It was not motivated to "sprint to parity," as some in the United States feared, or to compete with the United States to develop a national missile defense. And for the last three decades, the United States took little note of China in its decisions about strengthening its deterrence strategy and capabilities. But this somewhat relaxed state of affairs is changing. China's debate about the future of its strategic capabilities appears to be tied increasingly to its expected role as a dominant international actor in future decades. The US debate about future strike and defense capabilities will certainly account for likely responses by China. Thus, an action-reaction cycle is taking shape, along with some increased coupling of US and Chinese decision-making. A promising factor is that leaders of both countries profess an abiding interest in avoiding an arms race. They also have a shared interest in keeping the strategic military relationship from interfering with efforts to improve their political and economic relationships. In short, there may be an opportunity to open up practical dialogue, both official and unofficial, on such matters.

But the prospects for an agreement to engage in practical dialogue appear dim. Since the end of the Cold War, every US president has reached out to China in a bid to improve the strategic military relationship—and each has been rebuffed. The Obama administration pushed especially hard for a sustained, substantive, high-level process aimed at developing a mutual understanding of the requirements of strategic stability and of how to act, whether separately or together, to

Until calculations change in Beijing, it seems that the United States and its allies are likely to be left to manage the risks to strategic stability without Chinese partnership.

protect them. China never came to the table. Instead, it relied on unofficial channels, thereby denying the US government any opportunity to address official Chinese complaints about US strategic policy.[5]

Until calculations change in Beijing, it seems that the United States and its allies are likely to be left to manage the risks to strategic stability without Chinese partnership. Toward that end, they will debate whether the United States should continue or modify certain forms of restraint in missile defense and extended nuclear deterrence that it has heretofore exhibited toward China. This debate must account for the fact that strategic restraint in the name of stability, as sometimes practiced by the United States, can be received in Beijing (and elsewhere) as a signal of appeasement or decline. To address this misperception also requires a kind of dialogue that is not occurring.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

First, the United States and China could simply agree to disagree about the past and set aside questions about whose actions have been more injurious to strategic stability. They could simply move on to discussing present and emerging challenges.

Second, the two could stop asking each other to take steps they are unlikely to take. In the name of protecting strategic stability, China's experts have pushed the United States to abandon missile defense, not deploy hypersonic and other new conventional strike capabilities, end its practice of extended nuclear deterrence, and adopt a "no-first-use" policy, which would leave US allies unprotected from the North Korean threat. In contrast, US experts have pushed China to become fully transparent about its nuclear buildup, to join the US-Russian arms control process, and to admit that its no-first-use policy is a bit of a fraud. None of these steps will happen in the foreseeable future. Repeatedly demanding something unrealistic of a negotiating partner is an abnegation of responsibility.

Third, the nuclear-relevant dialogues that have been turned off could be turned back on. But to be productive, such dialogues would have to be sustained and substantive, by focusing on the challenges discussed above. Moreover, dialogues must be invested with high-level political focus and intellectual capital. Both are now in short supply, so an early priority should be to develop them.

To help prepare the needed intellectual capital, US experts have some homework to do. A key US task is to elaborate why China should do anything different. Many Chinese policymakers and experts share the conviction that China's nuclear policies and strategy have served the country well for decades and will continue to serve it well for the foreseeable future—and thus conclude that no changes to its transparency or other practices are warranted. Western demands for more transparency sound in China like Western demands to "become more like us—and then we'll feel better." A new argument must be made that (1) China's leaders have misdiagnosed the effectiveness of their strategy for preserving strategic stability, and that (2) they must, given China's rising military potential, do more to mitigate the shared risks of intensifying military competition and strategic instability. During the Cold War, it took the shock of the Cuban Missile Crisis and the rise of a dangerous arms race to shift thinking toward risk avoidance and risk management. In today's world, we should hope it will not require such a shock. Instead, a shift toward stability can occur if China quickly recognizes its own security dilemma—that as China becomes stronger, it will become less secure (given the reactions of others to China's new capabilities, strategies,

and ambitions)—and accepts that this reality will not change unless China can find new and better ways of assuring its neighbors that its rise will improve, not undermine, regional and strategic stability.

Official dialogue of a sustained and substantive kind is best enabled with a supporting track 1.5 process. The US government–funded US-China track 1.5 nuclear dialogue that began fifteen years ago was recently suspended in response to growing frictions, declining value, and the failure of a track 1 dialogue to launch.

Thus, **another near-term step would be for the two sides to renew the track 1.5 process and refocus it on the new challenges to strategic stability in an era of intensifying competition and risk.** The track 1.5 dialogue process is useful for generating shared insights into strategic stability and for developing new ideas for managing and reducing risks. But to be successful, it needs to be supported at the official level and protected from the vicissitudes of the broader political relationship.

Chinese Perspective

By Li Bin

STRATEGIC STABILITY IN AN ERA OF STRATEGIC COMPETITION

The traditional definition of strategic stability includes two key elements: crisis stability, which exists when neither state has an incentive to use nuclear weapons first in a crisis; and arms race stability, which prevails when neither state has an incentive to engage in an arms race. In both China and the United States, there are strategists who do not subscribe to these definitions. In China, some security experts tend to conceptualize strategic stability in broader, holistic terms. They believe nuclear issues are just one component of the strategic and political relationship between the two nuclear rivals that should not be isolated from the overall framework of the bilateral relationship. In the United States, some nuclear experts reject the idea of pursuing strategic stability with China for one or both of two reasons. The first is a concern that acknowledging US-China stability at a strategic level can undermine Japan-China stability at a conventional level, creating a stability/instability paradox.[6] The second reason is a calculation that damage limitation vis-à-vis China is achievable—in other words, the United States can reduce and withstand the damage caused by China's nuclear retaliation in a theoretical nuclear standoff.[7]

Notwithstanding these objections, this essay abides by the traditional conception of strategic stability, which is transparent, simple, and operational, and which hinges on the two key elements of crisis and arms race stability. The traditional definition was proposed and employed during a highly competitive period of the Cold War. It is based on worst-case assumptions and should be workable, even if we are entering an era of great power competition.

ENHANCING STRATEGIC STABILITY: CHALLENGES AND OPPORTUNITIES

Three types of factors may impact US-China strategic stability: the strategic force structure of the two states, which determines their nuclear retaliatory capabilities and thus their incentive to use nuclear weapons in a conflict; political and normative restraints on nuclear weapons use; and uncertainties inherent in nuclear calculations that may cause overreactions and nuclear escalation.

First, with regard to *strategic force structure*, typically the number of nuclear weapons possessed by two nuclear rivals is considered the independent variable in calculating the results of a potential nuclear exchange. Strategic stability in the US-China relationship, however,

changes very little if the United States changes the numbers of its nuclear weapons. After China deployed its first fixed-based long-range nuclear weapons in the 1980s, strategic stability in the US-China context began to rely, instead, on nuclear retaliation. Chinese nuclear deterrence provided by fixed-based nuclear weapons faded away over time because the locations of these weapons were revealed gradually. China then developed mobile intercontinental ballistic missiles and submarine-launched ballistic missiles to raise the survivability of its nuclear weapons. Whether these mobile weapons remain survivable depends primarily on US capabilities to detect and locate them.

The number of Chinese nuclear warheads that can survive a US first strike is not influenced by the total number of US nuclear weapons; it is proportional to the total number of Chinese long-range mobile nuclear weapons. China, therefore, is acutely sensitive to US efforts to locate these weapons, which explains Chinese efforts to disperse and hide them. Because China has a small number of retaliatory warheads, even a US missile defense system with a small number of interceptors poses a threat to China's nuclear deterrent capability. China could increase the number of its retaliatory warheads to overwhelm US missile defenses by increasing the total number of its long-range mobile nuclear weapons. But this is not an efficient way to respond to US missile defense. Various forms of technical penetration are more useful and less expensive. The size of the Chinese nuclear force is tiny compared with that of the United States. Within the foreseeable future, it is impossible for China to undermine the US retaliatory nuclear capability; it is also very unlikely that China will reach the level of the US force. From the perspective of US-China strategic stability, the numbers of their nuclear weapons are not very important. US missile defense, however, is a major challenge to stability. Other challenges include military intelligence technologies aimed at tracking mobile missiles such as space-based radars, anti-submarine sonar arrays, and image recognition enhanced by artificial intelligence.

Second, historical experiences suggest that *political and normative restraints* have played important roles in suppressing incentives to use nuclear weapons even when a nuclear-armed power may have calculated that its nuclear strike would not cause nuclear retaliation.[8] A taboo against the use of nuclear weapons is helpful in enhancing strategic stability. The more robust the taboo, the higher the level of strategic stability. It is possible that strategic stability based on mutual nuclear deterrence can occasionally be endangered if a nuclear weapons system malfunctions or a nuclear warning system is accidently interrupted. In this case, normative restraints play a key role in disincentivizing the use of nuclear weapons.

The nuclear taboo forms one of the key philosophical foundations of China's nuclear weapons policy, a fundamental tenet of which is "no first use" (NFU) of nuclear weapons. Chinese decision-makers understand that using a nuclear weapon first is not a realistic choice in a conflict, so it does not make sense for China to threaten to strike first with a nuclear weapon or to make plans for such a posture. Because China's nuclear weapons policy is based on a strong nuclear taboo, the Chinese strategic community is concerned by any erosion of that taboo.

Some American security experts worry that China is moving away from its NFU policy, while others do not consider the policy credible. Although there have been debates on the policy within China, there is no evidence that the Chinese government has any plans to abandon NFU. More worrisome are the interactions between the United States and Russia, including Russia's move toward an "escalate to de-escalate" strategy and the US deployment of low-yield nuclear warheads, both of which may weaken the nuclear taboo by creating the impression that nuclear weapons may be usable in conflict.[9]

Third, while states' respective nuclear weapons policies may or may not change the nuclear calculations of their adversaries, *inherent uncertainties in nuclear*

calculations may drive nuclear escalation and undermine strategic stability. For instance, a cyberattack against a rival state's nuclear weapons system can weaken its nuclear retaliatory capabilities and, consequently, undermine strategic stability. Even if the cyberattack is unsuccessful, the footprints of the attack may lead to dangerous consequences. The state that launched the attack may mistakenly believe that the attack has been successful and therefore become more willing to risk a nuclear exchange. The state on the receiving end of the attack may mistakenly worry that it has lost control over parts or all of its nuclear weapons system. It may take steps to test its ability to control its nuclear weapons, which could be viewed as a signal of escalation by its rival.

There have been frequent reports about cyber operations involving the United States and China.[10] The United States has a "left-of-launch" strategy that aims to use nonkinetic technologies such as cyber capabilities to disable a rival's missiles before they are launched.[11] It is not clear if the United States intends to use such operations against nuclear targets, but cyberattacks against nuclear weapons systems are certainly a new challenge to strategic stability, weakening nuclear retaliatory capabilities and introducing many uncertainties into nuclear calculations.

Another factor that increases uncertainty in nuclear calculations is rooted in the fact that many elements in conventional forces are similar to those used in nuclear forces, including some facilities for command and control, some delivery systems, and their logistic supports. For example, some US strategic bombers have conventional missions and some Chinese nuclear and conventional missiles are difficult to distinguish from each other. Dual-use systems add uncertainty to nuclear calculations in two ways. First, a country mobilizing its conventional systems may be perceived by its rival as preparing for nuclear war. Second, a country attacking the conventional targets of its rival may mistakenly damage the nuclear weapons capability of the rival. Nuclear escalation could ensue in either case. The development of cyber technologies makes this problem even more serious. Some conventional and nuclear systems may be geographically apart from each other, but they could be connected by data. Cyberattacks against conventional targets may spill over to nuclear systems.

Strategies involving the quick launch of nuclear weapons, such as the US "launch-on-warning" strategy, could raise the survivability of nuclear weapons and therefore enhance strategic stability in principle. However, such strategies also exacerbate nuclear escalation risks by leaving nuclear rivals with very little time in which to allay suspicions and clarify uncertainties in crises. Needless to say, leaders under extreme time pressure can make bad decisions. To avoid the risk of an accidental nuclear weapon launch, the United States and Russia should move their nuclear forces to low-alert status, and China should keep its forces at that status.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

Strategic stability in the US-China relationship faces great challenges, including policies and technologies on both sides of the relationship that undermine mutual nuclear deterrence, erode the nuclear taboo, and magnify uncertainties in nuclear calculations. Some of these policies and technologies are old and some are new. The United States and China need to take the following steps to respond to these serious challenges and to enhance strategic stability.

First, the two countries should create the political conditions necessary for their nuclear experts to be able to engage in dialogues on strategic stability at all levels. The two countries also need to encourage domestic debates about how best to strengthen stability, thereby developing in each country a domestic consensus on the strategy it should adopt in these dialogues.

Second, the United States and China should work together with the other members of the P5, the five nuclear weapon states recognized by the Nuclear Non-Proliferation Treaty, to develop a joint declaration that nuclear war should never be fought and that they will make every effort to protect the global nuclear taboo.

Third, the United States and China should develop mutually beneficial objectives for their engagement. The objectives should include an acknowledgment by the United States of China's nuclear deterrent and a commitment to exercise self-restraint in damage limitation efforts, and a commitment by China not to seek quantitative nuclear parity with the United States and to exercise self-restraint on the numerical development of nuclear weapons.

Fourth, the United States and China should encourage their technical experts to discuss confidence-building measures aimed at allaying suspicions and clarifying uncertainties associated with new technologies that impact the two countries' nuclear calculations.

The remnants of Plant 221, shown here on January 9, 2018, is the once-secret facility in China's northwest Qinghai Province where scientists built and detonated the country's first nuclear weapon in 1964. (Photo by Lam Yik Fei/New York Times)

Nuclear Forces and Strategic Stability

China's rapid expansion and modernization of its nuclear forces, coupled with the United States' own nuclear modernization efforts, have raised concerns that nuclear weapons are gaining salience in US-China strategic competition and that the two states are moving toward a destabilizing nuclear arms race. Patricia M. Kim and Jiang Tianjiao discuss Washington's and Beijing's fundamentally different nuclear doctrines and policies, which, in conjunction with growing mutual distrust, have prevented the two sides from taking major steps to enhance nuclear stability. Kim points out that many US observers do not find China's nuclear and missile modernization and buildup consistent with China's "no-first-use" policy. Jiang counters that advancements in US nuclear and missile capabilities are driving Beijing's modernization efforts and that Washington's calls for arms control are seen by many in China as a means to contain China. While recognizing the extreme challenges posed by these conflicting perceptions and deep mutual distrust, both authors suggest various steps the two sides can take in the near term. These include jointly affirming that nuclear war should never be fought and engaging in substantive track 1 and 1.5 dialogues to, at a minimum, deepen understanding of each other's strategic intentions and doctrines and to lay the groundwork for concrete steps in arms control, risk reduction, and crisis management mechanisms that can enhance strategic stability and prevent US-China conflicts from escalating into the nuclear realm.

US Perspective

By Patricia M. Kim

US AND CHINESE NUCLEAR CAPABILITIES

The United States is one of the world's largest nuclear powers, with a total inventory of 5,800 nuclear weapons. Approximately 1,600 of these are deployed across a nuclear triad of land-based intercontinental ballistic missiles, submarine-launched ballistic missiles (SLBMs), and at bomber bases within the country; 150 tactical bombs are also deployed at air bases in Europe. About two thousand of the United States' nuclear weapons are retired warheads awaiting dismantlement.[1] Although the United States and Russia collectively possess the vast majority of the world's nuclear weapons, the current US inventory reflects significant reductions from the latter years of the Cold War. After signing the US-Soviet Strategic Arms Reduction Treaty in 1991, the United States began to reduce the number and types of nuclear weapons in its strategic arsenal both to meet the obligations of the treaty and as part of its nuclear modernization process.[2] This trend held through the Obama administration, with the United States largely focused on modernizing its nuclear arsenal by extending the life of existing warheads as opposed to introducing novel nuclear weapons for new missions.[3]

The 2018 Nuclear Posture Review released by the Trump administration changed this trajectory, citing the need to respond to the "rapid deterioration of the threat environment" and to Russia's and China's expansion and diversification of their nuclear arsenals by deploying a new low-yield SLBM and developing a new sea-launched cruise missile, among other measures.[4] While the US government has plans in place to modernize all aspects of its nuclear triad and to add new warheads in the coming years, it remains to be seen how the Biden administration will pick up from where the previous administration left off.[5]

China is believed to possess at least two hundred and possibly more than three hundred nuclear weapons, with some observers contending Beijing's arsenal is as much as three times larger than the nonclassified estimates provided by the US government and various annual reports produced by the nuclear-watching community.[6] Although China's stockpile of nuclear weapons is much smaller than that of the United States, China is projected to at least double the number of its warheads over the next decade.[7] The uncertainty surrounding China's nuclear arsenal is driven by the fact that the Chinese government does not disclose basic data about the size of its nuclear arsenal nor provide extensive insights into its nuclear modernization and expansion efforts. The basic tenets of China's nuclear strategy include maintaining a "minimum nuclear deterrent" that provides China with a reliable second-strike capability (i.e., the ability to deliver a retaliatory nuclear strike in response to an adversary's initial nuclear attack), coupled with a "no-first-use" (NFU) of nuclear weapons pledge.

Despite Beijing's official policy of maintaining a minimal nuclear deterrent, it is rapidly modernizing and diversifying its nuclear forces as part of its drive to become a world-class military power by 2049. The People's Liberation Army is working to complete its own nuclear triad, including upgrading and developing new aircraft to field air-launched ballistic missiles, as well as improving its ground- and sea-based nuclear capabilities. There are also concerns among US observers that China is moving to field lower-yield nuclear weapons.[8] Finally, China's significant buildup of more than 1,250 ground-launched ballistic missiles and ground-launched cruise missiles, some of which are nuclear capable, have raised concerns in Washington and in other capitals about the potential for the use of nuclear

weapons in a US-China military standoff in the Indo-Pacific theater, such as in a conflict over Taiwan.

ARMS CONTROL AND RISK REDUCTION: CHALLENGES AND OPPORTUNITIES

The profound lack of trust and mutual skepticism of strategic intentions pose the greatest challenges to strengthening nuclear stability between the United States and China. Many in the US policymaking community believe China is expanding its military capabilities not just for defensive purposes. China's increasingly coercive behavior in recent years, such as its growing assertiveness in the Taiwan Strait, its militarization of disputed islands in the South China Sea, and its escalation of conflict along its disputed border with India, have deepened suspicion of Beijing's strategic intentions. According to the assessment of the 2017 US National Security Strategy, the US government considers China a "revisionist power" that seeks to "displace the United States from the Indo-Pacific region" and to "reorder the region" in its favor.[9] This deep mistrust pervades US perceptions of China's declared nuclear policies and its modernization efforts. While the most recent US Department of Defense assessment of China's military capabilities acknowledges that China has "long maintained an NFU policy," it also notes that Beijing's ambiguity on the application of its NFU policy and its lack of transparency on its nuclear modernization program "raises questions regarding its future intent as it fields larger, more capable nuclear forces."[10] In testimonies and public statements, Defense Department officials have more bluntly made the case that the rapid advancement of China's nuclear capabilities seems to be "increasingly inconsistent" with its stated NFU policy.[11] In addition, there are growing concerns that Beijing, despite official denials, is moving toward a "launch-on-warning" posture, which would enable it to rapidly launch nuclear missiles as soon as its system detects an incoming nuclear attack, increasing the risks of nuclear escalation.[12]

Chinese leaders and policy elites also fundamentally mistrust Washington and have long complained of what they perceive as US efforts to contain China's rise with its military might and regional alliances, and increasingly through economic and technological decoupling. Chinese policymakers point out that Washington has explicitly defined China as a "major strategic competitor" and is now using a "whole of government approach" to contain China.[13] According to China's 2019 defense white paper, the United States has "provoked and intensified competition" by "push[ing] for additional capacity in nuclear, outer space, cyber and missile defense, and undermined global strategic stability."[14] Chinese observers are particularly concerned that the United States is working to negate China's "minimal deterrent" by modernizing US nuclear forces and bolstering US defensive capabilities, including increasingly sophisticated satellite reconnaissance, forward-based radars, and ballistic missile defenses, in addition to non-nuclear strike capabilities. They also express alarm about the recent moves by Washington to expand its arsenal of low-yield nuclear weapons, pointing out that such moves lower the threshold for nuclear war. And because of the rapid deterioration of US-China relations, there are growing suspicions among some that the United States will take more "reckless" and "riskier military actions" toward China in the future, which have inspired calls for China to expand its own nuclear forces to prepare for a potential "full-scale showdown."[15]

In addition to the fundamental strategic mistrust that colors Beijing's and Washington's views of their respective nuclear forces, stark differences in the countries' nuclear strategies and policies that stem from their unique strategic circumstances also create difficulties for nuclear stability. Beijing, for instance, strongly believes its deterrent capabilities are enhanced by opacity and uncertainty. Such an approach contrasts sharply with Washington's traditional approach toward arms control and risk reduction, which, developed in interactions with Moscow, has been premised on quantitative parity and transparency through measures such as data exchanges, monitoring, and on-site inspections. When criticized for its secrecy, Beijing often responds that China's NFU

The fact that the United States and China share a mutual interest in global and regional stability and that neither side seeks military conflict with the other serves as a fundamental restraint on US-China conventional and nuclear escalation.

policy is sufficiently transparent and stabilizing, and contends that the United States' refusal to disavow first use of nuclear weapons is in fact destabilizing.[16] Because of Washington's extended deterrence commitments and the sensitivity of its allies, US leaders have shied away from explicitly acknowledging mutual vulnerability with China. As such, Beijing's demands for the United States to pledge no first use of nuclear weapons and Washington's demands for greater transparency into China's nuclear forces and strategic intentions have yet to generate momentum on advancing nuclear stability between the two powers.

Despite these serious challenges, the fact that the United States and China share a mutual interest in global and regional stability and that neither side seeks military conflict with the other serves as a fundamental restraint on US-China conventional and nuclear escalation. In fact, US public opinion polls consistently demonstrate that the American public views domestic issues such as the economy, health care, education, and the environment, not great power war, as top policy priorities.[17] In China, a recent public opinion study found that Chinese citizens also prefer devoting public funds to domestic priorities as opposed to military spending, and that nationalistic sentiments among the Chinese people are often paired with pacifist tendencies.[18] Moreover, going to war with the United States would ultimately jeopardize other aspects of China's quest for "national rejuvenation," which serves as a further restraint on escalating conflict.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

The sharp deterioration in US-China relations and growing mutual mistrust will continue to fuel an action-reaction cycle, pushing the two sides to develop increasingly cutting-edge strategic capabilities at the expense of nuclear stability. Given this, leaders in Washington and Beijing should take decisive action to recognize and mitigate the growing risks of a destabilizing US-China arms race and the prospects of nuclear confrontation between the two major powers.

First, US and Chinese leaders should agree to de-link strategic stability issues from all other bilateral challenges and pledge not to allow intractable conflicts in other issue areas to derail efforts to advance nuclear risk reduction, arms control, and crisis management.

Second, the United States and China should consider releasing a joint statement, along with the other P5 powers, reaffirming the 1985 Reagan-Gorbachev statement that a "nuclear war cannot be won and must never be fought." This statement should be coupled with a pledge to cooperate on reducing the dangers posed by nuclear weapons in the interim, while working toward their eventual elimination in the distant future. Such affirmations would reinforce global nonproliferation norms and could inject much-needed momentum into bilateral and multilateral efforts to avoid a great power arms race and to reduce the risk of nuclear war.

Statements alone are meaningless, however, without the operationalization of their principles. **Leaders in Washington and Beijing should restart dialogues at the track 1 and track 1.5 levels, designating special envoys to lead discussions and eventually negotiations on strategic stability measures.** These dialogues should aim to (1) at a minimum, deepen understanding of each other's nuclear doctrines and force postures; (2) explore the impact of nuclear modernization, technological advancements, and expansion of low-yield nuclear options on each side's key concerns and

interests, as well as potential rules and norms that can enhance nuclear stability; (3) include discussions on broader strategic military issues, such as regional flashpoints in the Indo-Pacific that impact the two states' respective strategic postures and policies, and particularly the security concerns of US allies and partners; (4) advance new crisis management mechanisms and the sincere implementation of existing ones to enhance crisis communication, avoid miscalculation, and build pathways for de-escalation; (5) explore technical capabilities and best practices for reducing the chance of false alarms and unintended nuclear escalation; and (6) investigate methods for arms control premised on implicit mutual vulnerability and not quantitative parity.

The United States should also advance parallel consultations with allies and partners to seek their input on measures to be explored bilaterally with China, *before* they are discussed in a bilateral or multilateral setting with Beijing. Close coordination will be essential to make certain that measures to strengthen US-China strategic stability are designed to simultaneously strengthen theater-level stability, and to ensure that they do not undermine US extended deterrence guarantees.

Chinese Perspective

By Jiang Tianjiao

US AND CHINESE NUCLEAR CAPABILITIES

For a long time, China has maintained nuclear strategic stability with the United States through asymmetric nuclear deterrence.[19] According to the Stockholm International Peace Research Institute, the United States has about 3,800 deployed and stored nuclear warheads, whereas China has only about three hundred.[20] Despite this disparity, China's reliable second-strike capability (i.e., its ability to retaliate against a nuclear attack with nuclear weapons) would make the United States think twice before using its nuclear weapons in the event of a war. However, the nuclear balance between China and the United States has undergone significant changes in the past few years.

On its side, the United States has more aggressively promoted the modernization of its nuclear weapons. In the 2017 National Security Strategy and the 2018 Nuclear Posture Review, the Trump administration explicitly listed China as a strategic rival and enhanced the role of nuclear weapons in the competition among major powers. On this basis, the United States plans to modernize various nuclear delivery systems—including the F-35 fighter, the B-21 bomber, and the Columbia-class submarine—and develop new types of nuclear weapons. Missile defense, of course, is closely related to nuclear strategic stability, and the Trump administration not only increased the budget for missile defense and vigorously developed the SM-3 Block IIA and other strategic interceptors, but also expressed interest in deploying missile interceptors in space. President Donald Trump himself said at the press conference held for the release of the 2019 Missile Defense Review that the United States would intercept incoming missiles "anywhere, anytime, anyplace."[21] Chinese nuclear specialists worry that the US missile defense is aimed at weakening China's second-strike capability.

For its part, China feels forced to respond to advancements in US nuclear and missile capabilities. One of the most high-profile, and controversial, expressions of this view was made by Hu Xijin, editor-in-chief of the *Global Times*, who said publicly in 2020 that China should increase the number of its nuclear weapons to at least one thousand.[22] The *Global Times* is widely seen as a mouthpiece for the Chinese government. Of course, many Chinese experts put forward different views at internal conferences. Some experts contend that if China's goal is purely to ensure effective nuclear deterrence, it

is more critical to improve the survivability of its second-strike forces than to expand the entire nuclear arsenal. Nevertheless, Hu's view certainly reflects the concerns of some people in China. Additionally, China is also developing its strategic technology. China's strategic bomber H-20 may soon be ready to go into service, thus forming the nuclear triad with the DF-41 intercontinental ballistic missile and the JL-3 sea-launched ballistic missile. In February 2021, China also successfully conducted a fifth land-based midcourse missile intercept test, underscoring the growing maturity of its intercept capability and combat effectiveness.

ARMS CONTROL AND RISK REDUCTION: CHALLENGES AND OPPORTUNITIES

Despite changes in the nuclear balance between China and the United States, the two countries have not prioritized the issue at the official level. This mismatch between the importance of the issue and its position on the bilateral agenda is due not only to inescapable political factors, but also to historical and strategic cultural factors. As the United States has continued its nuclear overhaul and launched a trade war against China, bilateral relations have deteriorated sharply. In a deeply and mutually mistrustful environment, China has reason to suspect that any US proposal to bolster nuclear arms control is really intended to solidify the United States' nuclear lead and contain China.

This situation reminds China of its unpleasant experience of nuclear threats by the United States during the Korean War.[23] From the 1960s to the 1970s, China repeatedly criticized the United States and the Soviet Union for failing to genuinely advance nuclear disarmament despite signing the Partial Nuclear Test Ban Treaty, the Nuclear Non-Proliferation Treaty (NPT), and the SALT treaties. Although China has actively integrated into the international community and participated extensively in various international arms control agreements since its adoption of the economic reform and opening-up policy in 1978, it has always insisted that the "two nuclear superpowers"—the United States and Russia—must work much harder toward nuclear disarmament, given that their arsenals are dozens of times larger than those of other nuclear powers.

Since the establishment of diplomatic relations between China and the United States, nuclear arms control has never been a priority issue in bilateral relations. In the 1980s, China-US relations were in a honeymoon period, and the United States acquiesced to China's gradual development of a reliable second-strike capability, while China took a moderate attitude toward the Reagan administration's Strategic Defense Initiative.[24] In the 1990s, despite twists and turns in bilateral relations, scholars and officials from both sides maintained semiofficial or nongovernmental contacts as they negotiated the Comprehensive Nuclear Test Ban Treaty (CTBT) and the indefinite extension of the NPT.[25] Unfortunately, the 1999 Cox Report put an end to these interactions. The report accused China of stealing "design information on the United States' most advanced thermonuclear weapons" and illegally obtaining US missile and space technology.[26] The report's allegations that lab-to-lab exchanges served as a "pipeline" for the transfer of secret information to China led to the suspension of technical exchange programs between the two sides.[27] During President Bill Clinton's visit to China in 1998, both countries issued a joint statement on the nontargeting of strategic nuclear weapons against each other, which was reaffirmed by President Barack Obama and President Hu Jintao in 2009. However, this commitment is largely symbolic, because missiles can be quickly retargeted. During the Obama administration, China and the United States did establish an official dialogue about the safety and security of nuclear materials and facilities, but the dialogue did not extend to nuclear weapons, deterrence, or arms control.

There are many reasons why the issues of nuclear strategic stability and nuclear arms control have not been at the top of the China-US bilateral agenda. From China's perspective, there is still a big gap between the two countries in terms of nuclear weapons, and there

is no basis for proportionate reductions in the size of their arsenals. China adheres to the principle of "no first use" and needs to maintain strategic ambiguity given its limited nuclear arsenal. The United States has never publicly acknowledged that China's strategic deterrence is powerful enough to guarantee "mutually assured destruction" in the event of a nuclear war. If the United States were to recognize that nuclear strategic stability exists between both countries or to propose arms control negotiations with China, it would not only reduce Washington's ability to use nuclear compellence against China but also make US allies that are embroiled in geopolitical competition with China worry that their interests will be sacrificed by the United States as it pursues better relations with China.[28] In short, many obstacles stand in the way of starting China-US nuclear arms control negotiations or even nuclear strategic dialogue.

The prospects, however, may have brightened because of the advent of the Biden administration. President Joe Biden and his foreign policy team appear to favor arms control and have rich negotiating experience. The Democratic Party's control of Congress may also open a rare window for promoting arms control. In recent years, many US think tanks and scholars have supported an open dialogue between the two countries on strategic stability, so as to manage their differences and avoid the dangers of a conflict escalating.[29] As for China, President Xi Jinping reiterated his support for building a noncon-frontational and peaceful bilateral relationship in a phone call with President Biden in February 2021. Considering that President Xi has actively supported the Nuclear Security Summit promoted by President Obama, it is still possible for China and the United States to deepen the nuclear dialogue to the strategic level. From the perspective of Chinese domestic politics, avoiding nuclear war and seeking a stable external environment are necessary conditions if the Chinese Communist Party is to realize its ambitious commitment—laid out in the recently formulated Fourteenth Five-Year Plan and 2035 Long-Range Objectives—to double per capita GDP and bring China into the ranks of developed countries.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

Although China and the United States have conducted track 1.5 and track 2 dialogues on strategic security in the past, the two sides often talk past each other and fail to bridge conceptual misunderstandings, which makes it difficult for the dialogues to feed into the policymaking process. Considering that the issues of nuclear strategic stability and nuclear arms control have been frozen for so long at the official level, the immediate priority should be to thaw this key issue, attract the attention of the two presidents, and gradually build mutual trust and a shared experience of constructive dialogue. Only on this basis can China and the United States carry out a formal nuclear strategic dialogue and perhaps even embark on nuclear arms control in this decade. The following three steps in this direction should be taken.

First, China and the United States should jointly approve the Comprehensive Nuclear Test Ban Treaty to finish what they started. The CTBT is the cornerstone of the nonproliferation and disarmament regime, but it has not yet come into effect. Until the United States, the world's largest nuclear power, commits itself to a ban on testing nuclear weapons, its sincerity in seeking arms control and disarmament will be viewed skeptically. Given that the extension of the New START Treaty does not need to be approved by Congress, the Biden administration should concentrate its political resources on ratifying the CTBT. A total ban on nuclear testing is also crucial for tackling climate change and fostering sustainable development, both of which the Biden administration has said it supports. If the United States ratifies the treaty, China will have no reason to refuse to follow suit.

Second, China and the United States should further strengthen dialogue among the permanent members of the UN Security Council and gradually accumulate experience in nuclear strategic dialogue. To avoid nuclear war and respond to the concerns of non-nuclear weapon states, the P5 should reiterate the Reagan-Gorbachev statement that "nuclear war cannot be won

and must never be fought." The P5 should continue to revise and update the Glossary of Key Nuclear Terms in order to increase mutual understanding in nuclear strategy and arms control. Regional nuclear proliferation issues also need the coordination of the P5. China and the United States have cooperated in the past on such issues, notably the Iran nuclear deal. If both sides can cooperate again, it will help to restore mutual trust.

Third, China and the United States should ensure that nuclear arms control enjoys a high profile in bilateral relations by linking the issue to other prominent agendas. In the past two decades, global governance issues—including terrorism, climate change, cybercrime, and the coronavirus pandemic—have emerged one after another, increasingly marginalizing the nuclear issue on the bilateral agenda. The leaders of the two countries have considered arms control at the Nuclear Security Summit but not when discussing bilateral relations. But, in fact, the nuclear issue is closely related to many global governance issues. For example, the Biden administration has prioritized combating climate change, and the Chinese government has expressed its willingness to cooperate with the United States on this challenge. China and the United States should jointly propose that avoiding nuclear war is a prerequisite for achieving green and sustainable development. Considering climate change while ignoring the risk of a nuclear winter caused by nuclear war makes no sense.

Trucks carrying parts of missile launchers and other equipment needed to set up the United States' Terminal High Altitude Area Defense anti-ballistic missile system arrive at Osan Air Base in Pyeongtaek, South Korea. (Photo by US Force Korea via AP)

Conventional Missiles, Missile Defense, and Strategic Stability

China's rapid expansion of its theater-range missile capabilities in recent decades and the United States' advantages in strategic and theater missile defense have long been points of contention in US-China discussions about strategic stability. Moreover, these disputes are not simply bilateral in nature but also involve the security interests of US allies in the region, which face a growing missile and nuclear threat posed by North Korea and an increasingly assertive and militarily capable China. In this section, Zhao Tong and Bruce MacDonald discuss the perception gaps between the United States and China concerning the threats posed by their respective missile and missile defense capabilities. MacDonald's essay presents a number of arguments advanced by US experts to counter Beijing's claims that US missile defense is undermining China's strategic nuclear forces at the expense of mutual vulnerability. Zhao's essay discusses why these arguments have failed to reassure China and prevent its nuclear and missile modernization efforts, and how a continued action-reaction cycle may lead to a dangerous and costly arms race. Both authors advance a number of concrete ideas, including dialogues that enhance transparency, political assurances that address the root drivers of regional anxiety, and innovative arms control frameworks and engineering measures that can help the United States and China preempt an arms race and reduce the risks of unintended nuclear escalation.

Chinese Perspective

By Zhao Tong

US AND CHINESE MISSILE AND MISSILE DEFENSE CAPABILITIES

The United States already possesses many of the most advanced air- and sea-based conventional missiles in the world. In anticipation of intensifying military competition with Beijing, Washington is rapidly expanding production of existing models of cruise missiles and developing new types of ballistic, cruise, and hypersonic missiles. China has different strengths. It has a clear advantage over the United States in terms of land-based medium- and intermediate-range missiles (chiefly ballistic missiles but augmented by some cruise missiles), as a result of the fact that China was never constrained by the Intermediate-Range Nuclear Forces Treaty that existed between the United States and the Soviet Union/Russia between 1987 and 2019. China has acquired considerable experience in developing and operating such weapon systems, which makes China confident that it will be able to maintain this advantage in the future.[1] As an example of China's unique capability in this area, it operates the world's first anti-ship ballistic missiles, such as the DF-21D and DF-26.

China has had success in incorporating hypersonic missile technologies into its theater-range missile capabilities. Its DF-17 missile is the first-ever land-based medium-range boost-glider missile. In contrast, the United States, until recently, focused primarily on developing cutting-edge technologies for long-range hypersonic systems. In recent years, however, the United States has shifted its focus toward quickly developing operational theater-range hypersonic missiles. Several American hypersonic missile programs are under fast development simultaneously, potentially shifting the future balance of capability in this area in favor of the United States.[2]

In terms of missile defense, the United States enjoys a clear capability advantage over China across the board, ranging from strategic (homeland) to theater missile defense technologies and from land-based to sea-based systems.[3] The backbone of the US strategic missile defense—the Ground-Based Midcourse Defense interceptors—are deployed only in limited numbers, with forty-four interceptors in total, and have encountered technological challenges with the development of an effective hit-to-kill vehicle. In contrast, US theater-range missile defense systems have been proven to be more technologically mature and successful. Some of these systems, such as the Aegis, may even be capable of contributing to US strategic defenses under certain conditions. Missile defense is also an important area of defense collaboration and cooperation between Washington and its security allies.[4]

China is a latecomer in developing modern missile defense technologies. Its indigenous programs, however, have benefited from the introduction of Russian systems and from steady government investment over recent decades. China has reportedly conducted successful midcourse intercept tests against medium-range ballistic missile targets and is developing longer-range technologies with an intent to deploy missile defense systems both on land and at sea. It is also gradually building up a network of satellites and land-based radars to detect and track incoming missile attacks and guide its missile defense systems.[5]

ARMS CONTROL AND RISK REDUCTION: CHALLENGES AND OPPORTUNITIES

China sees its large stockpile of conventional theater-range missiles as a key instrument for safeguarding its territorial integrity and deterring external (i.e., American) military intervention in areas such as the Taiwan Strait, the South China Sea, and the East China Sea. Due to the perceived high stakes, China is unlikely to willingly rein back

A major domestic obstacle to diplomatic engagement comes from the main beneficiaries of an arms race—the military-industrial complex in both countries.

the future development of such missile capabilities. At the same time, the rapidly growing US investment in similar capabilities, including conventional hypersonic missiles, may present a growing challenge to China's traditional advantage and military strategy. The risk of an arms race is growing. US interest in forward deploying such missiles on allies' territories close to China, together with Chinese efforts to pressure US allies to resist such deployment, may fuel fierce diplomatic struggles that undermine regional stability. In the midterm future, growing US capabilities may force China to rethink its approach and may even open a new opportunity for arms control talks, but that same growth could also backfire by strengthening the Chinese determination to outcompete the United States.

A major domestic obstacle to diplomatic engagement comes from the main beneficiaries of an arms race—the military-industrial complex in both countries. The history of the development of conventional hypersonic missiles, for example, reveals a process in which technology has driven military strategy. This trend may become more pronounced as both countries make more resources available to the defense industries against the background of great power competition. Domestic checks and balances, it may be noted, are highly asymmetrical insofar as Chinese academia, media, and civil society have traditionally played a much smaller role than their US counterparts in monitoring and pushing back against the military-industrial complex.

The increasing entanglement between conventional and nuclear missile systems and their enabling capabilities presents a growing risk of ambiguity and misunderstanding that could lead to inadvertent escalation during crises. Chinese theater-range missile systems are particularly entangled, as the DF-26 intermediate-range ballistic missiles can carry either a nuclear or a conventional warhead and the DF-21 medium-range ballistic missiles have nuclear and conventional versions that look alike. Future US systems may become further entangled as Washington introduces more dual-use capabilities, such as a new type of nuclear cruise missile that may serve side by side with conventional cruise missiles on nuclear attack submarines.[6] The United States may also move toward further integrating offensive and defensive weapon systems, as highlighted by proposals to make the SM-6 air-defense missiles multirole and enable them to also strike land and surface targets, a trend that could create new ambiguity and heighten the risk of misunderstanding in a conflict. Neither government has paid enough attention to the implications of entanglement, but this could change if the two countries explore the possibility of jointly studying the effects of entanglement and offense-defense integration on strategic stability.

US missile defense has been the greatest external driver of China's nuclear modernization efforts over the last few decades.[7] The two countries have never launched any regular official dialogue on strategic stability and have a significant perception gap over the potential impact of US missile defense on China's nuclear second-strike capability. If their failure to bridge the gap persists, Beijing is likely to continue building up its nuclear forces, which may inspire fear in Washington that Beijing is transitioning to a more aggressive nuclear posture. This negative action-reaction cycle might lead to a costly strategic arms race. New and destabilizing weapon systems to overcome missile defense may be studied more seriously—a path that Russia has taken by developing intercontinental-range nuclear torpedoes and nuclear-powered cruise missiles. The United States and China share a responsibility to preemptively defuse such a costly and dangerous arms race.

No country forever sits on one side of the offense-defense competition equation. China, for example, is also developing its own midcourse missile defense

technologies and may cause India, a smaller nuclear rival, to worry about the credibility of its nuclear deterrent vis-à-vis China. If China recognizes the fact that it may in the future be on the other side of the offense-defense competition equation, China may pay more serious attention to the need to pursue cooperative measures to address existing and future disputes with the United States over missile defense. A more flexible US attitude on missile defense would also go a long way toward raising Chinese interest in jointly resolving the US-China missile defense dispute, or at least jointly mitigating its impact on bilateral strategic stability.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

Risk reduction measures are clearly in both countries' interests—something that senior Chinese officials have publicly confirmed—and joint discussions on such measures should be possible to arrange in the near future. High on the agenda should be the risk of entangled missile systems. One specific item in need of clarification is the nature of their respective hypersonic missiles: will current and future hypersonic missiles be armed with nuclear or conventional warheads, or will they be built to serve as dual-capable weapons? There is no evidence that either country has sought to deliberately use entanglement in a way to manipulate risk and maximize deterrence benefits, and such transparency measures would help reduce the danger of inadvertent conflict escalation.

To contain the theater-range conventional missile arms race would serve both countries' interests. However, achieving this goal requires innovative arms control options. Given the asymmetric capabilities of the two sides, one option raised by some Chinese experts is to regulate air-, sea-, and land-based missile systems in an integrated framework so that the two countries would agree to some upper limit of their total arsenals without losing the freedom to decide which types of weapons to prioritize according to their unique security needs. The technical complexity of such an arms control framework would prevent formal negotiations starting within the next few years, but initial joint studies between the expert communities from the two countries can and should begin to examine the practicality of such ideas.

Furthermore, both countries need to recognize the connection between conventional missiles and missile defense. China's growing conventional missile forces stoke concerns in Japan about Chinese conventional military threats, and prompt Japan to lobby the United States against committing to a stable US-China nuclear relationship. When discouraged by its allies from explicitly committing to a stable nuclear relationship with Beijing, Washington is unlikely to be very interested in addressing Beijing's concern about US strategic capabilities, including missile defense. For this reason, it would be useful for China to provide security assurances to Japan and other US allies in the Asia-Pacific region; such assurances, for instance, could involve addressing the allies' perceptions of the threat posed by the capability and employment strategy of China's conventional missile forces. Another step Beijing could consider taking along this line is to pledge a nonmilitary resolution of its territorial disputes with US allies—a stance that should be consistent with China's traditional foreign policy principles.

Both the United States and China should recognize that there is no fundamental conflict of interest over the issue of US strategic missile defense. The official US objective is to counter the missile threats from so-called rogue states, and Washington has a clear interest in preventing its missile defense from undermining great power strategic stability. With this in mind, government-affiliated experts from the two countries should start a joint study to examine the technical feasibility of the United States building a strategic missile defense system that can effectively intercept North Korean intercontinental ballistic missiles without seriously threatening China's. Such a joint study, which should use only open source data, can serve as

an important near-term confidence-building measure, because it may help narrow disagreements down to technical issues and contribute to building common understandings at the political level. The United States should not worry about losing control of its own missile defense policy through engagement with China, as there is still room to work together to discuss and address Chinese concerns without having to impose any hard and immediate limits on future US missile defense capabilities.

US Perspective

By Bruce MacDonald

US AND CHINESE MISSILE AND MISSILE DEFENSE CAPABILITIES

The US need for offensive conventional missiles has declined since the days of the Cold War, although prompt long-range hypersonic strike missiles have become a newer priority and several versions are under development. Medium-range US missiles fall mostly in the category of defensive missiles. Examples include the SM-3 interceptor, which is part of the Aegis Ballistic Missile Defense System and the Terminal High Altitude Area Defense (THAAD) system, both of which are used to defend against short- to intermediate-range ballistic missiles. The United States' homeland missile defense system, known as Ground-Based Midcourse Defense, has forty-four interceptors with plans to deploy an additional twenty, for a total of sixty-four.[8] The limited development of the US arsenal since President Ronald Reagan's announcement of the Strategic Defensive Initiative in 1983 is a noteworthy sign of US restraint.

China has a substantial arsenal of medium- and intermediate-range missiles, including over two hundred DF-26 intermediate-range missiles, more than 150 medium-range ballistic missiles, and a number of anti-satellite–oriented ballistic missiles.[9] According to the US Department of Defense, "The PRC has utilized Russian-developed missile defense systems while indigenously producing its own increasingly capable missile defenses and radars. The PRC's missile defense capabilities are focused on regional threats but appear to be developing towards countering long-range missiles."[10]

ARMS CONTROL AND RISK REDUCTION: CHALLENGES AND OPPORTUNITIES

Three specific capabilities have direct bearing on strategic stability in the US-China relationship: missile defense against conventionally armed ballistic missiles; missile defense against conventionally armed hypersonic ballistic missiles; and conventional missiles used against key elements of nuclear command and control.

Missile defense against conventionally armed ballistic missiles becomes an issue for strategic stability when the defense in question is so capable that it begins to pose a challenge to long-range ballistic missiles. China and Russia have long protested that advancements in US missile defense are undermining their strategic nuclear forces and eroding mutual vulnerability. China has specifically protested the deployment of the THAAD missile defense system in South Korea even though the United States has made clear that THAAD is intended to defend against ballistic missiles from North Korea, not China. Beijing's complaints have been met with skepticism in Washington because, depending on China's exact missile launch points, avoiding and/or outrunning THAAD interceptors would be a fairly straightforward exercise for Chinese missiles.[11] THAAD and SM-3 are decidedly nonoptimal weapons for the mission that China worries those missiles may secretly have. If the United States' true intention was to negate China's strategic deterrent, it could have developed more capable missiles and deployed them on ships in the area. But the United States has not taken such

Some fear that a hypersonic weapon fitted with a highly accurate and non-nuclear warhead could make a disarming first strike against an adversary's missile silos and other key vulnerable targets with scant warning. . . . a prescription for rushed, and perhaps unwise, decision-making.

actions thus far and has not indicated any plans to do so in the future. In addition, the United States' cancellation of the advanced SM-3 Block IIB in 2013, and the Japanese decision in June 2020 not to deploy the Aegis Ashore system to defend Japan against North Korean ballistic missiles, may provide some space for dialogue to reach an accommodation to resolve the understandable concerns of both countries.[12]

In the case of defense against conventionally armed hypersonic ballistic missiles, there is a key misunderstanding in Beijing about the nature of the threat. Chinese experts have voiced concerns that the United States could launch a disarming first strike against China's silo-based intercontinental ballistic missile force with a hypersonic ballistic missile and even against its road-mobile force if remote detection capabilities become sufficiently advanced.[13] Some fear that a hypersonic weapon fitted with a highly accurate and non-nuclear warhead could make a disarming first strike against an adversary's missile silos and other key vulnerable targets with scant warning and without crossing the nuclear threshold.[14] This capability would give the targeted country's leaders little time to decide how to respond—a prescription for rushed, and perhaps unwise, decision-making. The combination of short flight duration from extended distances and extreme accuracy could enable the United States, it is argued, to make a successful first strike and not even breach the nuclear threshold, putting China in a challenging position, given its "no-first-use" policy on nuclear weapons. China has indicated that such a strike would be tantamount to a nuclear first strike and that it would respond accordingly, bringing nuclear war closer.[15]

A crude but straightforward form of missile defense offers a solution to this challenge but is consistently overlooked. Igniting conventional explosives near each Chinese missile launcher when a nearby hypersonic object is detected would throw a large amount of gravel and debris into the air, which the hypersonic vehicle would encounter and then be either deflected or destroyed. Even if the vehicle avoided the debris, it would still need to hit its target precisely, given that its non-nuclear warhead would have a small kill radius. If the vehicle carried a nuclear warhead, the whole issue would be moot, as there would be a confirmed nuclear detonation on sovereign Chinese soil. By using such measures, the risk of nuclear escalation due to a conventional hypersonic attack could be blunted at low cost and with little technical sophistication.

In the case of conventional missiles used against key elements of nuclear command and control, both the United States and China have overlooked the extent of the challenges.[16] The term *nuclear entanglement* refers to how a country's nuclear capabilities can become deeply entangled, or intertwined, with its non-nuclear capabilities. Since China's 2007 anti-satellite test, Chinese military officials and analysts have made clear that US overhead persistent infrared (OPIR) capabilities, such as the Space-Based Infrared System and Defense Support Program satellites, would become legitimate targets if China and the United States became embroiled in a purely conventional conflict.[17] US expressions of caution to China on targeting these foundational components of the US strategic nuclear architecture in a conventional conflict have elicited little more than a shrug from Chinese counterparts. This raises the specter of Chinese attacks on an essential part of the US nuclear infrastructure when, with conventional conflict already underway, tensions would already be at a fever pitch. The seriousness with which the United States would treat such an attack is underscored by the 2018 Nuclear Posture Review, which explicitly states that the United States could employ nuclear weapons in response to "attacks on U.S. or allied nuclear forces [or] warning and attack assessment capabilities."[18]

As fraught with danger as this situation is, future prospects are even more worrisome. Currently, the OPIR remote sensing constellation is arguably the most entangled non-nuclear military capability coupled to the US strategic nuclear triad. In a bid to make US strategic early-warning capabilities more resilient in the face of attack, constellations of disaggregated satellites are being considered. There is great merit in this idea, but it also presents potential pitfalls. Disaggregating the system and putting tactical capability into low Earth orbit (LEO) could be problematic due to the demonstrated efforts by China—and, more recently, India—to make LEO a more vulnerable environment through either kinetic or nonkinetic attacks. Also, recent proposed efforts to create LEO mesh networks by SpaceX, Amazon, OneWeb, and other commercial enterprises would not only increase the congestion in LEO but also introduce additional radio and physical interference. One could project that with a substantial increase in LEO satellites in the coming decades, there could be a time when a missile's trajectory is either not initially detected or the detection is interfered with as a result of congestion in LEO.[19] Challenges will continue to increase no matter where infrared payloads are orbiting; therefore, it is important to clarify with all major space powers each nation's strategic assets and seek in the event of conflict to identify ways to avoid such redlines and prevent a conventional conflict from escalating into nuclear war.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

A positive step forward for the United States and China would be to conduct a dialogue at the track 1, 1.5, and 2 levels to focus on the challenges discussed above. There is very little downside to such discussions, and the benefits are many in terms of reducing misunderstanding, achieving greater clarity on each nation's concerns, and providing channels of communication that could advance the interests of both sides. Information sharing and transparency should be part of this dialogue to the extent possible.

To remove any confusion and solve the entanglement issue, the United States should have an easily distinguishable set of OPIR satellites dedicated to theater detection and another at a different orbital altitude for strategic OPIR. While the tactical system may have some strategic capabilities, it would not be optimized for that mission. This would help prevent China from inadvertently attacking US strategic command and control, which might trigger nuclear escalation.

Such confidence-building measures, however, would have limited impact on regional tensions, given China's increasingly aggressive behavior and unilateral actions over the last twenty years in territorial disputes—actions that have fueled concern and apprehension among its neighbors. As such, **a US-China strategic stability dialogue should start a complementary conversation about the root causes of US and US allies' anxieties in East Asia, including North Korea's aggressive behavior and the nuclear threat it poses to the region.** It would be constructive to have a dialogue on what could allay Japan's and South Korea's understandable and legitimate concerns, and the struggle over theater missile defense may be ameliorated if progress could be made on this challenge.

Dialogue and joint study of common problems may also open doors for cooperation and for advancing technical measures based on creative engineering, design, and arms control concepts such as enforceable keep-out zones for satellites, so that high-value satellites remain protected, though this would require discussion and negotiation between the parties.

US Air Force General Jay Raymond, chief of space operations, presents President Donald Trump with the official flag of the Space Force in the Oval Office at the White House on May 15, 2020. (Photo by Samuel Corum/New York Times)

Strategic Stability in Space

US-China strategic competition in space is heightening, with both states viewing the other's advancing space capabilities apprehensively. In this section, Frank A. Rose and Guo Xiaobing discuss the challenges to enhancing strategic stability in space, including the United States' and China's respective advancements in anti-satellite capabilities, their divergent views on space-based missile defense, and the potential for conflicts in space to trigger nuclear escalation. Although they both recognize the need for bilateral space engagement, the two authors differ slightly on areas to prioritize, with Guo expressing hopes for greater civil and commercial space cooperation (while recognizing the limits of such endeavors in the near term), and Rose highlighting the need to balance potential pragmatic civil space cooperation with broader national security concerns. Both Rose and Guo agree that the United States and China have a mutual interest in maintaining stability in outer space and recommend that the two sides resume and expand their various space security–related dialogues to address critical issues such as the potential deployment of space-based missile defense systems; threats to space-based nuclear command, control, and communications systems; and managing increasing space congestion by cooperating on limiting orbital debris.

US Perspective

By Frank A. Rose

US AND CHINESE SPACE CAPABILITIES

In recent years, China has embarked on a major expansion of its national security space programs. The most concerning of these programs to the United States has been China's development of a robust set of anti-satellite capabilities designed to target satellites and disrupt the flow of space-derived information. According to several US government and other open source reports, China is developing and deploying a full spectrum of anti-satellite capabilities. These include a network of space situational awareness sensors capable of searching, tracking, and characterizing satellites in all Earth orbits; electronic warfare capabilities designed to jam satellite transmissions; laser weapons to disrupt, degrade, or damage satellites and their sensors; offensive cyber capabilities to target computer networks; sophisticated on-orbit satellite attack capabilities; and ground-based missiles designed to destroy satellites kinetically.[1]

China is also improving and expanding its other national security space capabilities, including its deployment of constellations of intelligence, surveillance, and reconnaissance (ISR) and precision, navigation, and timing satellites.

The Chinese People's Liberation Army (PLA) has also conducted a major reorganization to better integrate space, cyberspace, and electronic warfare systems with its other military capabilities. The most significant of these reforms was the establishment of the PLA Strategic Support Force (SSF) in 2015. According to the US Defense Intelligence Agency, "The SSF forms the core of China's information warfare force, supports the entire PLA, and reports directly to the Central Military Commission."[2] Furthermore, as a RAND Corporation report notes, "The creation of the SSF suggests that information warfare, including space warfare . . . appears to have entered a new phase of development in the PLA."[3]

The United States possesses the largest and most sophisticated set of national security space capabilities in the world, and the US military is highly dependent on space-derived data to conduct military operations. The US Department of Defense (DOD) deploys multiple constellations of satellites to perform various missions, including missile warning, communications, weather, and positioning, navigation, and timing. The US intelligence community operates a separate set of satellites in support of ISR missions. In addition to its satellite capabilities, the DOD deploys a series of ground- and space-based sensors and telescopes, known as the Space Surveillance Network, that are used to track objects in outer space.

The most significant space security development in the United States in recent years has been the establishment in 2019 of the US Space Force, the sixth US military service. The US Space Force is responsible for organizing, training, and equipping space forces in order to protect US and allied interests in space and to provide space capabilities to the joint force. The US Congress established the Space Force in direct response to the growing anti-satellite threat to US and allied space systems.[4] In 2018, the United States also reestablished US Space Command, the eleventh combatant command in the US military, in response to the emerging anti-satellite threat. Currently, US Space Command "conducts operations in, from, and to space to deter conflict, and if necessary, defeat aggression, deliver space combat power for the Joint/Combined force, and defend U.S. vital interests with allies and partners."[5]

ARMS CONTROL AND RISK REDUCTION IN SPACE: CHALLENGES AND OPPORTUNITIES

The US government and independent experts have expressed concern that US nuclear command, control, and communications (NC3)–related satellites are

Decades of space activity have littered Earth's orbit with defunct satellites and pieces of orbital debris. . . . Experts warn that the current quantity and density of manmade debris significantly increases the odds of future collisions either as debris damages space systems or as colliding debris creates more space debris.

increasingly vulnerable to threats from anti-satellite weapons. For example, the 2018 Nuclear Posture Review states that "a number of countries, particularly China and Russia, have developed the means to disrupt, disable, and destroy U.S. assets in space. Because space is no longer an uncontested domain, U.S. NC3 space systems need to be more survivable, defendable, and provide resilient capabilities."[6] China does not currently possess a robust space-based NC3 capability but, according to the DOD, it is working to develop such a system.[7] Were China or another potential adversary to use an anti-satellite weapon against a US satellite that was part of its NC3 system, it could escalate a conventional conflict in a direction that neither side anticipates nor desires. Given the potential implications of such a situation, finding pragmatic ways to reduce the possibility of miscalculations related to space-based NC3 systems should be a top priority.[8]

Decades of space activity have littered Earth's orbit with defunct satellites and pieces of orbital debris. The DOD is currently tracking over 26,000 pieces of orbital debris 10 centimeters or larger. Experts warn that the current quantity and density of manmade debris significantly increases the odds of future collisions either as debris damages space systems or as colliding debris creates more space debris. Because of the high speeds at which these objects travel in space (17,500 miles per hour in low Earth orbit), even a submillimeter piece of debris could cause a problem for human or robotic missions. Some of this debris is the result of routine space operations; other pieces are a result of deliberate acts and accidents. The orbital debris situation continues to deteriorate due to several key events, such as China's 2007 anti-satellite test against one of its own satellites and an accidental collision in 2009 between a defunct Russian Kosmos satellite and a commercially operated Iridium satellite.

In addition to the growth of orbital debris, the deployment of mega constellations of small satellites by US, European, and Chinese entities are contributing to congestion in space. For example, SpaceX has plans to deploy a constellation of small satellites called Starlink that will ultimately consist of 42,000 small satellites. Furthermore, in December 2018, Aerospace Dongfanhong, a Chinese state-owned satellite manufacturing company, launched the first demonstration satellite for the Hongyan communications constellation of small satellites. The Hongyan constellation will ultimately consist of 320 satellites and is expected to be fully operational by 2025. Although this constellation is significantly smaller than Starlink, it is likely only a matter of time before China's approach to mega constellations becomes more ambitious.

Space-based missile defense is another area ripe for conflict. China views such capabilities as an existential threat to its strategic nuclear deterrent. Indeed, a key strategic objective of China's outer space diplomacy has been to constrain the deployment of US space-based missile defense capabilities. For example, China's two primary space diplomatic initiatives—the No First Placement of Weapons in Outer Space resolution adopted by the UN General Assembly in December 2016 and the draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects—are focused on limiting space-based missile defense capabilities. The United States has strongly opposed both of these proposals, arguing that they are not effectively verifiable, would not constrain terrestrial-based anti-satellite weapons, and do not adequately define a weapon in outer space.

Although the US Congress has yet to fund a space-based missile defense interceptor program, were the United States to fund the deployment of space-based interceptors or direct energy systems, it would

likely trigger a response from both China and Russia. Preventing the deployment of such systems, and disabling or destroying them early on in a conflict, would likely be a top priority for both countries. Thus, the deployment of space-based missile defenses could potentially impact strategic stability calculations.

In recent years, the United States has expressed concerns about Russian and Chinese satellite maneuvers that have sometimes come close to US and allied space systems. In 2018, it was reported that a Chinese satellite, the Shijian-17, had "executed 'proximity operations' with at least four Chinese satellites."[9] Furthermore, in February 2020, it was reported that a Russian satellite, Kosmos 2542, had conducted maneuvers close to two US national security satellites.[10] These types of maneuvers have the potential to increase miscalculations and misperceptions in space, as well as to lead to collisions between spacecrafts.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

The two sides should reestablish the US-China Space Security Talks, which were largely dormant during the Trump administration. These talks, last held in December 2016, discussed a wide variety of subjects, including threat perceptions, diplomatic initiatives, transparency and confidence-building measures, and efforts to address the challenge of orbital debris. The forum could also be used to address each side's respective concerns about the threat to space-based NC3 systems and the potential deployment of space-based missile defense systems. However, to be effective, the talks will need to include the right set of experts, including senior representatives from the DOD and PLA.

The United States and China should also explore ways to limit debris-generating events in outer space, which threaten the space systems of both nations. There is already a solid foundation of cooperation in this area to build on. For example, in 2015, the United States established a direct link between the US Joint Space Operations Center and the Beijing Institute for Telecommunications and Tracking to provide China with more timely conjunction assessments and collision avoidance notifications.[11] Additionally, during President Barack Obama's September 2016 visit to China, the two sides "committed to intensify cooperation to address the common challenge of the creation of space debris and to promote cooperation on this issue in the international community."[12] Building on this previous work, the two sides could issue a joint statement committing to refrain from conducting debris-generating tests against space objects. Upon reaching an agreement bilaterally, the two sides could invite other nations to make similar statements and coauthor a UN resolution to strengthen the international norm against debris-generating events in space. Although such a statement would not ban anti-satellite weapons per se, it would be an important step in helping slow the growth of orbital debris.

Additionally, **the United States and China should consider options for developing norms of behavior for rendezvous and proximity operations, which have the potential to both increase tensions in outer space and cause collisions between satellites.**

Finally, **the two sides should examine ways to improve bilateral cooperation on pragmatic civil space projects.** Increased cooperation in this area could improve trust and reduce the risk of miscalculation in space. Given that the Chinese civil space program is controlled by the military, any cooperation will need to be carefully calibrated to ensure it does not contribute to China's military space programs. This is conceivable, given that the United States was able to cooperate with the Soviet Union on civil space programs during the Cold War without undermining national security. If the United States and China ultimately seek to expand civil cooperation, the US Congress would likely need to modify or remove current legislative restrictions on that cooperation.[13] The US Congress is unlikely to make any significant changes to the legislation, however, unless it is part of a larger strategy that seeks to balance civil cooperation with broader national security concerns.

Chinese Perspective

By Guo Xiaobing

US AND CHINESE SPACE CAPABILITIES

It is generally agreed that the United States is either the sole space superpower or one of two such superpowers, the other being Russia. It has the most advanced space technology, the most active space operations, and the most comprehensive military space strategy and space force structure. It is the official policy of the United States to develop and, if necessary, use space weapons. This stance was made clear in February 2019, when President Donald Trump signed Space Policy Directive-4, which declares that the US Space Force should "include both combat and combat support functions to enable prompt and sustained offensive and defensive space operations." The directive further states that one of the priorities of the Space Force is to project "military power in, from, and to space in support of our Nation's interests."[14]

The United States also has very strong counterspace capabilities. According to a report released by the Secure World Foundation in April 2020, the United States has conducted multiple tests of co-orbital anti-satellite (ASAT) technologies that can be used to attack satellites in both low Earth orbit and geostationary orbit. Its mid-course missile defense interceptors can also be used to attack satellites, as demonstrated by the United States' intercept of the satellite USA-193 in 2008. Furthermore, the United States has extensive experience in developing conventional and nuclear-tipped direct-ascent anti-satellite (DA-ASAT) weapons. The country's operational Counter Communications System is able to jam signals from communication satellites, and its space situational awareness system, the most advanced in the world, can help it obtain a clearer picture of what is happening in outer space.[15]

In the last few years, space-based nuclear weapons and missile defenses have attracted a lot of attention in the United States. For example, in 2018, Vice President Mike Pence, then chair of the US National Space Council, discussed the possibility of deploying nuclear weapons in space if necessary.[16] The following year, the 2019 Missile Defense Review declared that the United States would examine "the concepts and technology for space-based defenses."[17] A space-based system, said the report, has three advantages. First, it may increase the overall likelihood of successful intercept. Second, it may reduce the number of US defensive interceptors required. Third, it could destroy offensive missiles over the attacker's territory rather than over the targeted state.

China is an important emerging space power, having made significant progress in recent years in the areas of space launches, human spaceflights, navigation systems, and lunar exploration. At present, China ranks high in the second echelon of nations conducting launches into space. Just as China is well known for its "no-first-use" policy in the nuclear arena, China is also known for its policy opposing the weaponization of space. What China means by the nonweaponization of space is that states should "not place any weapons in outer space" nor "resort to the threat or use of force against outer space objects" with either land-, sea- or air-based ASAT weapons.[18]

According to the Secure World Foundation's assessment, China does have potential counterspace capabilities. However, "there is no public evidence of China actively using counterspace capabilities in current military operations."[19] For instance, although it has tested co-orbital technologies, there is no proof that these technologies will be used for counterspace purposes. China also has DA-ASAT capabilities, but they are not operational.[20] Similarly, China is trying to improve its space situational awareness capabilities, but still lags far behind the United States.

ARMS CONTROL AND RISK REDUCTION IN SPACE: CHALLENGES AND OPPORTUNITIES

Three major challenges prevent the United States and China from advancing measures for arms control, risk reduction, and cooperation in space.

First, the United States and China have deep mutual distrust and serious concerns about each other's intentions and capabilities in space. From China's perspective, the essence of US space strategy is to dominate space. President Trump's assertion that "the United States is taking steps to ensure that American national security is as dominant in space as it is here on Earth" left a deep impression on Chinese officials and their understanding of US strategy.[21] China suspects that the US ambition of dominating space is the real reason behind its opposition to the Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects. This suspicion seems to have been confirmed by US endeavors to develop military space capabilities, including, but not limited to, space-based missile defenses. Chinese scholars are also concerned that the US threat to use nuclear weapons in retaliation for space attacks will lower the nuclear threshold and increase the probability of nuclear escalation.

The United States seems to view China's intentions in space with similar suspicion. For instance, the 2020 Defense Space Strategy claims that "China has weaponized space and turned it into a warfighting domain." It also asserts that "China's development, testing, and deployment of counterspace capabilities present the greatest strategic threat."[22] Moreover, the United States regards the China-Russia proposal for preventing space weaponization as "hollow and hypocritical."[23]

Second, there are political obstacles. Exchanges and cooperation may help the two nations better understand each other and enhance stability in space. For instance, civil space cooperation enables members of the space community to become familiar with one another and sends strong signals of cooperation rather than confrontation. Unfortunately, however, space policy toward China has become a highly politicized issue in the United States. This development preceded the Trump administration, beginning with the release of the Cox Report in the late 1990s, after which space cooperation with China gradually became a taboo topic in the US political arena.

Many politicians who oppose China for political and ideological reasons have tried to exaggerate the potential danger posed by Sino-US space engagement, linking it to irrelevant issues such as religious freedom and human rights and maintaining that the United States can cooperate with all major powers except China. The situation has worsened with the deterioration of the bilateral relationship over the past several years. More and more Chinese aerospace enterprises and research institutes have been blacklisted by the US Department of Commerce's Bureau of Industry Security. Against this backdrop, supporters of bilateral space cooperation in the United States tend to tread cautiously, fearing they will be accused of being indifferent to national security concerns.

Third, restrictive legislation hinders space cooperation. Some pieces of US legislation limit or block US-China space engagement, such as the "Wolf Clause," which was signed into law in 2011 and restricts funding for US-China space cooperation. The United States has repeatedly used provisions in this legislation to keep Chinese space experts from visiting the United States and to prevent Chinese reporters from conducting interviews at US space launches. Such restrictions, of course, also impede bilateral space talks and exchanges.

Although the prospects for engagement are not very encouraging overall, there are some bright spots. In particular, there are two specific opportunities to enhance strategic stability in space. First, both the United States and China are highly reliant on space assets. Neither of them would benefit from a war in

outer space and both want to ensure that their space assets can operate safely. Therefore, they have a common interest in preventing military escalation in space and reducing space debris. Second, bilateral talks over space security and civil space cooperation have continued despite the turbulent bilateral relationship. From 2011 to 2016, the two countries held six rounds of strategic security dialogue within the framework of the US–China Strategic and Economic Dialogues.[24] And in 2016, China and the United States began separate talks on space security that addressed the issues of arms control and confidence-building measures. Additionally, in June 2019, the US deputy assistant secretary of state for defense policy, emerging threats, and outreach discussed outer space security and other strategic issues with his counterparts from the Chinese Foreign Affairs Ministry.[25] Since 2015, China and the United States have also held three rounds of civil space dialogue.[26] This dialogue focuses on the issues of space debris, space weather, and climate change. Furthermore, China and the United States have a track 2 dialogue focusing on space debris.[27]

CONCRETE STEPS TO TAKE IN THE NEAR TERM

First, China and the United States should resume and strengthen track 1 and 1.5 dialogues on space security. With the risk of space weaponization increasing rapidly, serious discussions must begin on the creation of a multilateral treaty banning attacks on space assets and prohibiting the deployment of space-based weapons. Such a treaty could effectively mitigate both countries' concerns about surprise counterspace attacks from the other. Conversations at the track 1.5 level, such as dialogues cosponsored by the China Foundation for International and Strategic Studies, the Center for Strategic and International Studies, the Pacific Forum, RAND, and the Institute for Defense Analysis from 2004 to 2019, have begun to address the issue of space security. If the two sides can resume such dialogues in the near future, this will allow policy experts and scientists to come together for comprehensive talks on space policy, space security, and the intersection of space and nuclear strategic stability.

Second, China and the United States should continue to expand civil space dialogues. The two sides should explore potential cooperation on space exploration, space debris reduction, and space security standards. It is also in both countries' interests to promote cooperation on using space technology to deal with major natural disasters.

Third, China and the United States should explore the possibility of engaging in commercial space cooperation in the future. From 1988 until the release of the Cox Report in 1999, China and the United States enjoyed a golden era of commercial space launch cooperation. While cooperation on commercial space launches is unlikely to resume in the foreseeable future, some new avenues for bilateral cooperation may be opening, such as in the areas of space mining and space tourism.

Initiating cooperation in less sensitive areas may create momentum for cooperation on more sensitive issues, which in turn will increase mutual dependence and encourage the exercise of self-restraint in the event of a crisis in space. The US Congress should also review its restrictive legislation and create an environment that allows for US-China engagement in space.

China's President Xi Jinping on screen during the World Internet Conference in Wuzhen, China, in November 2020. President Donald Trump subsequently banned US telecommunications firms from installing foreign-made equipment that could pose a threat to US national security. (Photo by Aly Song/Reuters)

Strategic Stability in Cyberspace

The cyber domain has become an increasingly salient arena of conflict, with the potential for clashes in cyberspace to escalate into kinetic warfare. Given the vulnerability of critical infrastructure, including core nuclear command and control systems, to cyberattacks, the United States and China share an interest in defining redlines in cyberspace and working to reduce escalation risks. In this section, Lyu Jinghua and Adam Segal outline the barriers the United States and China face in advancing stability in cyberspace, including difficulties differentiating between defensive and offensive cyber activities, a lack of mutually agreed-upon norms of behavior in cyberspace, and pervasive strategic distrust that leads to worst-case assumptions about the other side's cyber activities. While the list is long, the fact that both authors identify and conceptualize many of the challenges similarly demonstrates that both Chinese and American experts recognize the grave risks associated with US-China conflicts in the cyber realm. In their essays, Lyu and Segal present concrete ideas on how the United States and China might enhance stability in cyberspace, including engaging in dialogues that can increase transparency and understanding of each other's cyber operations and doctrines, establishing communication channels that can be used during a cyber crisis, and working toward rules of behavior to keep sensitive infrastructure, such as core nuclear command and control systems, off-limits to cyber intrusions to prevent miscalculations and unintended escalation into kinetic, and even nuclear, conflict.

Chinese Perspective

By Lyu Jinghua

US AND CHINESE CYBER CAPABILITIES

Unlike assessing capabilities in traditional domains such as land, air, and sea, it is almost impossible to apply a quantitative approach to the study of cyber capabilities, especially those designed for military purposes. The reasons for this include the secrecy governments maintain regarding their military cyber capabilities and the kinds of vulnerabilities they might target; the blurred lines between facilities and techniques used by both civilians and the armed forces; the lack of widely accepted standards to measure cyber power; and the inability to know how extracted data might be used or altered.

That said, both China and the United States are working to assess each other's cyber capabilities and the threats they pose. While China has never publicly announced the establishment of a cyber force, it is widely believed in the West that the Strategic Support Force of the People's Liberation Army leads a cyber force responsible for information operations.[1] US reports conclude that China is able to conduct cyberespionage that could cost the United States hundreds of billions of dollars annually, carry out cyberattacks with "localized, temporary disruptive effects on critical infrastructure," and potentially thwart US attempts to respond to such attacks.[2] The US Department of Defense (DOD) described China's cyber capabilities as "rudimentary" in 2000, but in 2018 it listed China as the most serious source of cyber threats facing the United States.[3]

China views the United States as the most powerful country in cyberspace, and one which, together with other Western countries, exerts dominance over internet resources. The United States' superiority stems from the location of root servers (one main server and nine of twelve auxiliary servers are based in the United States); the close relationship between the United States and the Internet Corporation for Assigned Names and Numbers, which manages key elements of the internet, such as the domain name system; and the size and sophistication of American high-tech companies. In 2013, Edward Snowden reinforced preexisting concerns that the US government uses private tech companies to hack Chinese networks when he revealed in an interview that the US National Security Agency's PRISM program targets Chinese civilians and institutions.[4] China is also alarmed by the rapid development of US cyber forces, with the creation of the US Cyber Command in 2010 and its elevation to the status of a unified combatant command in 2018. It is also concerned about US cyberattacks against foreign countries, noteworthy examples of which include the use of a computer worm called Stuxnet against Iran's nuclear centrifuges and the cyber-enabled "left-of-launch" attacks against North Korea's missile system. China strongly believes that US cyber policy is becoming more aggressive. This belief is driven by doctrinal changes reflected in DOD documents that emphasize "persistent engagement" and "defending forward" to "disrupt or halt malicious cyber activity at its source."[5] Moreover, a 2018 presidential directive reportedly eased the approval process for offensive cyber operations below the level of "use of force."[6] China's concerns over a more aggressive US cyber policy is reflected in its 2019 national defense white paper, which asserts that the United States has "pushed for additional capacity in nuclear, outer space, cyber and missile defense, and undermined global strategic stability."[7]

There are few discussions in the public domain among Chinese scholars on how China-US cyber conflicts might unfold. However, the conflict scenarios described by US sources share several common features. First, the conflicts all start as disputes between China and its East Asian neighbors, with the United States being asked to provide assistance to its allies or partners. Second, the main goal

of the described cyberattack is either to delay the deployment of armed forces or to display power to psychologically impact the other side. Third, the major targets of the cyberattacks include electric grids, military communication systems, commanding systems of individual weapon platforms such as warships, and networks used for organizing and distributing logistical support. Finally, both sides show some restraint in the expected goal and range of targets and seek de-escalation afterward. Chinese academics do not believe that China would act preemptively or target critical civilian infrastructure.

ENHANCING STRATEGIC STABILITY IN CYBERSPACE: CHALLENGES AND OPPORTUNITIES

In general, there are three main challenges facing the United States and China in advancing stability in cyberspace. The first arises from the nature of cyberspace, which presents difficulties in terms of accurately attributing malicious cyber activities to the culprit in real time; deciphering intentions behind an intrusion and distinguishing cyberespionage from cyberattacks; and controlling the secondary effects of cyberattacks. Given the strong mutual suspicion between the United States and China regarding each other's strategic intentions, coupled with the fact that both view the other as holding aggressive cyber postures, they will be inclined to perceive cyber activities in terms of worst-case scenarios. They are likely to assume that a potentially damaging cyber activity conducted by the other represents a serious and deliberate attack rather than thinking that it is the result of a mistake or that they have misinterpreted the other's intentions. Such assumptions, in turn, may cause them to overreact or act preemptively.

A second challenge is that diverging assessments of each other's capabilities in cyberspace further complicate China-US dynamics. China views itself as lagging far behind in cyberspace, and thus assumes that the United States can easily decipher Chinese actions in cyberspace and differentiate between cyberespionage and cyberattacks. In contrast, many experts in the United States tend to believe that China's cyber capabilities are now more or less equal to that of the United States and that China is increasingly confident in its abilities.[8] And they see the United States as asymmetrically vulnerable to hostile foreign activity in the cyber domain, given the open, decentralized nature of the US economy and infrastructure.[9]

The third challenge concerns third parties, which can further muddle an already complex situation. A third party, whether a state or nonstate actor, can create or manipulate crises and conflicts in many ways. For instance, a third party could disguise itself as a US or Chinese government actor in order to mislead one side into believing the other is launching an attack. It is also possible for either of the two countries to disguise themselves as a third party or employ proxies such as criminal hackers to carry out cyber operations against each other.

In addition to these general challenges, there are also two significant risks specific to the cyber-nuclear nexus. The first is the modernization (i.e., digitalization) of nuclear systems, which inevitably introduces new cyber vulnerabilities that are not yet fully understood. The compartmentalization of the two domains and the lack of communication between the experts and agencies working in the cyber and nuclear realms could increase the associated risks. The second is the different conceptions of "security" in the two areas. In the nuclear arena, security equates to being free from nuclear attacks through clear signals of deterrence. In the cyber domain, however, security is achieved by detecting malicious activities as early as possible and involves constantly intruding into the different nodes of one's major adversaries to understand their capabilities and vulnerabilities. Therefore, penetration testers, white hat hackers, and others who probe nuclear systems may not be fully aware of the gravity of the threat that their "routine" activities could pose. Meanwhile, security experts in the nuclear arena may be inclined to overinterpret cyber activities detected in nuclear systems. Despite these challenges, one positive development is that the danger of cyber operations disrupting nuclear systems and leading to crises that can

Given the importance of the digital domain to national strength and its implications for strategic stability, establishing agreements on the prevention of armed conflicts or nuclear war triggered by cyber risks would serve the interests of both [China and the United States].

spill over into armed conflicts or even nuclear war is fully recognized by influential scholars in both countries.[10]

More importantly, with the advent of a new administration in Washington, hopes have risen that the two countries will continue to compete in various ways but will work harder to avoid military confrontation, and that the resumption of China-US talks on security issues can defuse conflicts and reduce misunderstandings. Given the importance of the digital domain to national strength and its implications for strategic stability, establishing agreements on the prevention of armed conflicts or nuclear war triggered by cyber risks would serve the interests of both parties. The principles found in the 2015 US-China Cyber Agreement, the 2013 and 2015 UN Group of Governmental Experts (GGE) reports, and China's recently proposed Global Data Security Initiative provide an essential foundation for such efforts.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

First and foremost, the United States and China must work to build trust given that the most destabilizing factor in both cyber and other domains is the increase of mutual suspicion. Although the two powers may not view each other as long-term friends with good intentions, they can rebuild basic trust by reassuring each other that they have no interest in creating or taking advantage of crises and that they are committed to avoiding military confrontations, especially nuclear war. The two sides should work to establish new channels of communication and utilize existing ones such as the high-level US-China Diplomatic and Security Dialogue and the lower-level Joint Staff Dialogue to explain their respective cyber strategies, policies, capabilities, and intentions. In this way, the two sides can at least reduce misunderstandings and thus lower the desire to "act first" or "defend forward" based on incorrect assumptions. Although transparency is often the basis for building trust, it is only feasible in the cyber domain to have transparency of intentions and postures, not transparency in terms of statistics of weaponry and forces.

Second, the United States and China need to devote greater attention to crisis management. This includes (1) recognizing and communicating via both track 1 and track 2 dialogues what actions in cyberspace are stabilizing or destabilizing; (2) exploring whether and how to share information, such as broadening the range of information shared between respective Computer Emergency Response Teams to include information on threats with potential strategic consequences during peacetime and establishing a hotline between the DOD and the Chinese Ministry of Defense to use immediately before and during a cyber crisis; (3) expanding existing confidence-building measures, such as the two memoranda of understanding between the countries' defense departments on the notification of major military activities and the rules of behavior for the safety of air and maritime encounters, into cyberspace; and (4) advancing communication between nuclear and cyber agencies both within each country and between the two sides.

Third, the two sides should explore committing themselves to a number of self-restraints and mutual restraints. In the cyber domain, there are a wide variety of restraint measures to choose from. The GGE, for instance, suggests self-restraint norms such as refraining from attacking critical infrastructures and impairing the work of Computer Emergency Response Teams. The OECD may also serve as a platform for the two countries to discuss norms of behavior in cyberspace.[11] The 2015 US-China Cyber Agreement contains a commitment to refrain from conducting or knowingly supporting the cyber-enabled theft of intellectual property. Looking at the cyber-nuclear nexus, the United States and China should discuss the possibilities of making commitments to not conduct cyber intrusions into core nuclear command, control, and

communications systems; to require that senior leadership authorize cyber operations targeting nuclear systems; and to exercise effective oversight and control over third-party actors. A major concern that needs to be addressed in this area is how to verify commitments. For example, many in the West question China's willingness to carry out the commitments laid out in the cyber agreement. China, however, firmly believes that it has been fulfilling its obligations. The key to resolving this issue is to identify a qualified actor, either an individual or institution, to determine and implement effective verification methods.

Last but not least, the two should restart joint efforts to develop international norms for the prevention and management of cyber conflicts. China and the United States should also explore approaches to effectively attribute cyberattacks and should promote the implementation of international laws in cyberspace.

US Perspective

By Adam Segal

US AND CHINESE CYBER CAPABILITIES

Given the secrecy and opacity that surround most cyber operations, it is extremely difficult for outside observers to assess relative national cyber capabilities. Policymakers have few incentives to be more transparent. Revealing the ability to conduct specific operations or the impact of the cyber tools in a country's arsenal could result in adversaries reconfiguring their systems and thus the subsequent loss of those capabilities. In addition, much of the public's sense of cyber capabilities comes from the reporting of private cybersecurity firms, selected releases to the media, and attribution of attacks from a small set of countries, mainly the "Five Eyes."[12] Attribution capabilities, which rely on a combination of human and signals intelligence as well as digital forensics, are unevenly distributed, and the decision to publicly "name and shame" an attacker is political, and thus not always made.

Even with these caveats in mind, it is probably safe to say that the United States and China are two of the most capable among the seven or so state actors most active in cyberspace. US Cyber Command now has 133 offensive, support, and defensive cyber teams, and, along with Israel, it allegedly conducted one of the few known cyberattacks to have caused physical destruction: the Olympic Games operation against Iran's nuclear program at Natanz. It has also reportedly destroyed data on networks belonging to Iran's Revolutionary Guard, preplaced malware on Russian critical infrastructure and disrupted Russian election interference, and sabotaged the Islamic State's online propaganda.[13] In addition, as revealed by the contractor Edward Snowden, the National Security Agency has conducted widespread espionage campaigns by exploiting software and hardware vulnerabilities, supply chains, and fiber-optic cables. The United States also has the world's largest commercial cybersecurity sector.[14]

Compared with the United States, Chinese capabilities and doctrine are probably less developed. The Chinese leadership announced in 2015 an increasing focus on network defenses in the People's Liberation Army (PLA) and the establishment of the Strategic Support Force. These forces combine space, cyber, and electronic warfare units and will be critical to China's ability to maintain information dominance in wartime. According to media reports, Chinese cyber espionage operations have targeted the networks of the US government, defense bases, the private sector, media, and civil society organizations, as well as similar targets in Europe, Japan, India, and Southeast Asia. In 2015, Admiral Mike Rogers, then head of Cyber Command and director of the National Security Agency, told a congressional panel that China and "one or two" other countries would be capable of mounting a cyberattack that could shut down the power

grid or other critical infrastructure.[15] UglyGorilla, one of the five PLA hackers indicted by the US Department of Justice, reportedly hacked into the computers of a public utility in the northeastern United States, perhaps to map the system in preparation for a future attack.[16]

Military planners in both countries expect offensive cyber operations to be part of any conflict between the United States and China. Open source articles from PLA analysts often stress the need to seize information dominance at the beginning stages of a conflict through cyberattacks against command and control computers as well as satellite and communication networks.[17] The PLA would also attempt to disrupt US forces in the Western Pacific through attacks on transportation and logistics systems. Some Chinese analysts also believe that cyberattacks can have a deterrent effect, given the United States' dependence on banking, telecommunication, and other critical networks.[18] A highly disruptive attack on these networks might reduce the chances that the United States would involve itself in a regional conflict.

US defense planners view cyber operations as a tool with which to counter Chinese efforts to disrupt US power projection in the Western Pacific. US cyberattacks, accompanied by long-range precision strikes on command and control nodes, missiles, surface ships, submarines, and aircraft, would be used against the PLA in the early stages of a military conflict.

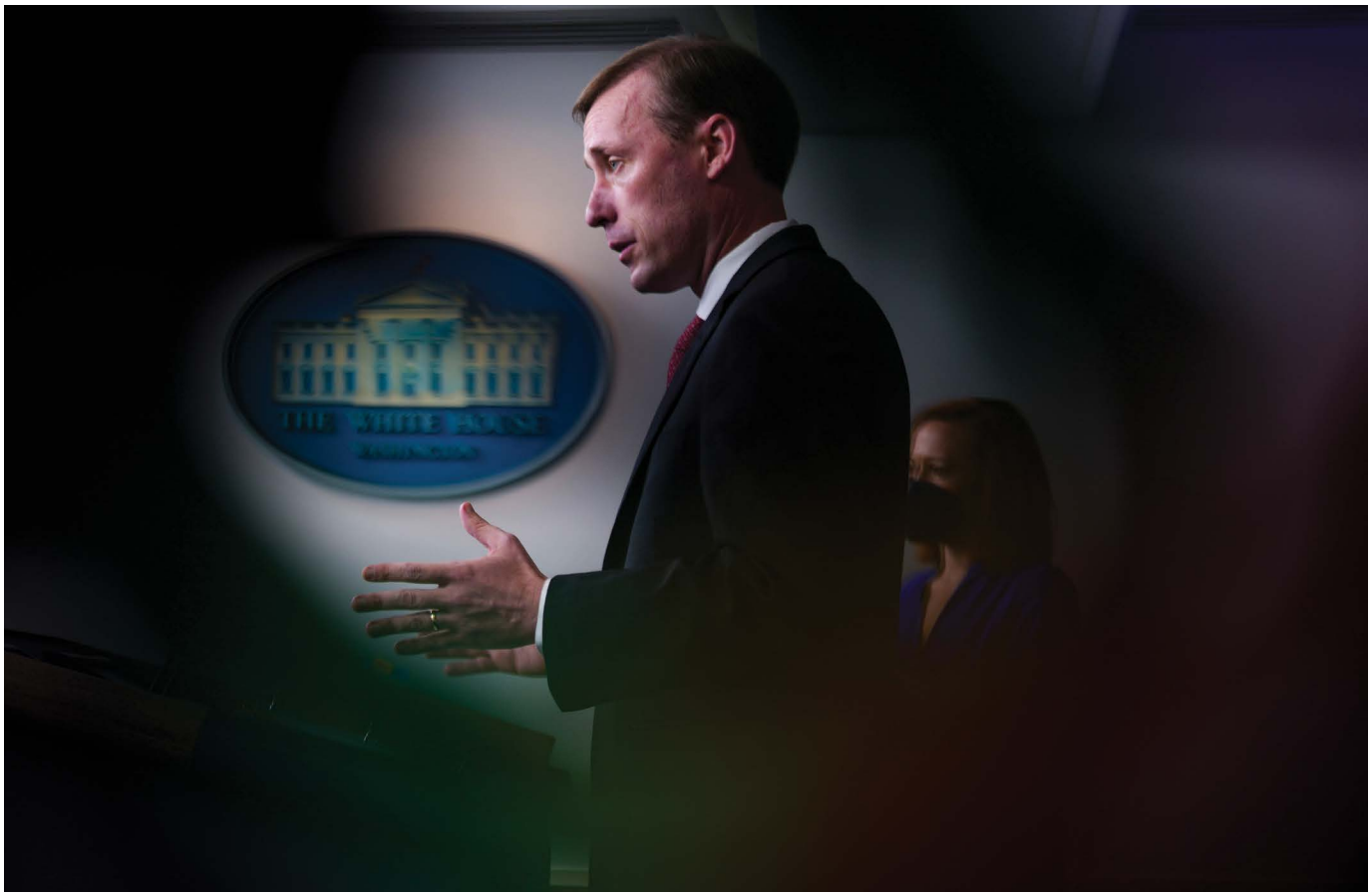
ENHANCING STRATEGIC STABILITY IN CYBERSPACE: CHALLENGES AND OPPORTUNITIES

The combination of technical, strategic, and political factors makes it extremely difficult for Washington and Beijing to advance arms control, risk reduction, and crisis management measures in cyberspace over the next decade. Ben Buchanan, a scholar of cybersecurity at Georgetown University, for example, describes a cybersecurity dilemma wherein defensive actions in cyberspace can appear offensive to a potential adversary.[19] Certain espionage attacks are difficult to differentiate from operations that could enable high-end, destructive cyberattacks. In addition, US Cyber Command has adopted a doctrine of "persistent engagement" and "defending forward" that blurs offense and defense. Public descriptions of the doctrine are vague and include the deployment of cyber protection teams to allied nations, the sharing of intelligence with the private sector, and the use of malware within adversary electrical grids. Defensive measures to disrupt, deny, or deter attackers taken by Cyber Command could look to an adversary like preparations for an attack or an actual attack.[20]

The lack of clear thresholds on the use of force, low barriers to entry, the willingness of some states to rely on proxy actors, and the possibility of false flag operations all appear to increase the chances that a cyber conflict will spill over into the physical world. The cyber domain also appears to be characterized by a "use it or lose it" pressure. Cyberattacks that blind sensors and confuse decision-makers, alone or in parallel with kinetic attacks, could prompt both sides to rush to preempt or escalate. Although there is a growing body of academic literature questioning whether cyberspace is a fundamentally escalatory domain, spillovers from the cyber to the kinetic world remain a possibility under intense geopolitical competition.[21]

Moreover, there are strong concerns that a cyberattack on nuclear communications, command, control, and intelligence and other systems could undermine launch abilities and generate strong crisis instability. The complexity and entanglement of nuclear systems with other systems mean that cyber operations could produce unexpected and unintended outcomes. Intelligence gathering could be interpreted by the defender as efforts to degrade nuclear capabilities and could spill over into critical systems. Cyberattacks on nuclear systems could produce false warnings or miscalculations, interfere with communications or access to information vital to decisions about the use of nuclear weapons, increase the risk of an unauthorized use of a weapon, or undermine confidence in the nuclear deterrent, affecting strategic stability.

The technical and operational barriers to conflict management in cyberspace are magnified by strategic



National Security Advisor Jake Sullivan speaks at the White House on March, 12, 2021. The sophisticated hacks pulled off by Russia and China are driving the Biden administration and Congress to rethink how the nation should protect itself from growing cyberthreats. (Photo by Doug Mills/New York Times)

competition and political mistrust. The overall worsening of the security environment between Washington and Beijing appears to raise the possibility that a cyberattack will spill over into kinetic conflict.

Proponents of defending forward will point to the apparent breakdown of the 2015 agreement between President Barack Obama and President Xi Jinping on industrial cyberespionage as evidence that norms have little effect on state behavior. The agreement, which was signed after Washington called out Chinese cyberattacks and threatened sanctions against high-level officials, was meant to prohibit the theft of intellectual property and business secrets from the private sector. The agreement did not include verification measures or sanctions for violating the agreement, however. Beijing appears to have used the time after the signing to reorganize its cyber forces, and soon returned to cyberattacks on the private sector.[22]

In the light of the Snowden revelations, Beijing sees American rebukes of Chinese behavior in cyberspace as hypocritical and disingenuous. Moreover, over the last decade, cyberespionage, cybersecurity, and technology more broadly have moved from being obscure issues to central irritants in the bilateral relationship. Beijing and Washington are now competing over a range of emerging technologies, including 5G cellular technology, semiconductors, and artificial intelligence, that will shape capabilities in cyberspace.

The growing vulnerability of both China and the United States to cyberattacks does create a shared interest in defining some norms of responsible state behavior in cyberspace. Chinese leaders may have believed they were less vulnerable to cyberattacks when the economy was less developed, but in 2019 China's digital economy accounted for 36 percent of the country's

GDP. Both sides have similar interests in preventing destructive attacks on shared financial or internet infrastructure.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

The most important first step is for the United States and China to engage in official dialogue that could improve mutual understanding of each other's cyber operations and doctrine. Although the Trump administration held a dialogue between the US Department of Justice (DOJ) and Department of Homeland Security (DHS) and China's Ministry of Public Security (MPS) on cybercrime and law enforcement, and several track 1.5 and track 2 discussions on cybersecurity took place, there appear to have been no meetings between the two countries' militaries. Discussions between the two sides could help clarify escalation risks.[23] The two sides will also want to discuss their command and control structures for cyber forces, because tight political control over cyberattacks may keep attacks more precisely targeted and the risks of collateral effects lower. Confidence-building measures may also help achieve greater transparency between the two sides. These could include exchanges about cyber doctrine, greater exchange of information during cyber incidents, and identifying points of contact for communication during a cyber crisis. It will be especially important to insulate these talks, as much as possible, from becoming hostage to the ups and downs in the bilateral relationship. In the past, China cancelled a military dialogue to signal displeasure, notably after DOJ indicted five alleged PLA hackers for cyberespionage in May 2014. The need for the group to meet is bound to be most pressing when tensions between the two countries are highest.

Washington and Beijing also lack a crisis communication mechanism specific to cyberspace. DHS and MPS established a hotline in 2016, but it was focused on cybercrime and appears to have consisted of a dedicated email address. The United States and Russia have a direct line in place for crisis communication as well as a mechanism for noncrisis information exchange between the two countries' nuclear risk reduction centers. A dedicated communication line could prove essential during a crisis in preventing miscalculation and escalation.[24]

The two sides should also consider public statements of self-restraint, especially in regard to intrusions into nuclear command and control systems that could be misperceived as preparations for an attack. In a 2015 UN report, representatives from twenty countries, including the United States and China, known as the Group of Governmental Experts (GGE), agreed to norms of peacetime behavior in cyberspace. One of those norms was that nations should not conduct any activity that "intentionally damages critical infrastructure or otherwise impairs the use and operation of critical infrastructure to provide services to the public." At a summit in September 2015, Presidents Xi and Obama "welcomed" the development of these norms. Since then, however, the gap between the two sides has grown. Washington wants to use the GGE process to discuss the application of international law and the laws of armed conflict to cyberspace. Beijing argues that these discussions accelerate the "militarization" of cyberspace and is working with Russia to promote an international code of conduct for information security.

Beijing and Washington should continue these norm discussions in the United Nations, the ASEAN Regional Forum, and other multilateral settings. But the priority should be bilateral meetings that bring together cyber operators from both sides. Without these discussions, China and the United States are likely to be ignorant of many of the assumptions of the other side, and thus the risk of escalation and spillover will grow significantly.

A Chinese flag flies near a Hikvision security camera monitoring a traffic intersection in Beijing on October 8, 2019. (Photo by Mark Schiefelbein/AP)

Artificial Intelligence and Strategic Stability

Rapid advancements in artificial intelligence (AI) and its incorporation into military capabilities by both the United States and China have raised concerns about the impact of AI on current and future conflict dynamics. As Qi Haotian and Lora Saalman discuss in this section, AI can have both stabilizing and destabilizing effects. For instance, while AI could enhance global arms control by improving monitoring and verification capabilities, it could also weaken strategic stability if AI-supported intelligence, surveillance, and reconnaissance (ISR) systems function too well and provoke fears in states about the credibility and integrity of their strategic deterrent. Although AI-driven improvements to early warning and ISR may help quickly deliver more data to leaders during conflicts, such advancements, in addition to automation, speed up the conflict environment and can narrow the window for de-escalation and diplomatic mediation. Both Qi and Saalman make the case that the United States and China share a strong interest in developing common understandings of the risks associated with the increasing application of AI to their military, and especially nuclear, forces. They recommend that the two sides engage in track 1 and 1.5 dialogues on the implications of AI for the future of warfare and to work toward rules and norms, and eventually binding multilateral agreements, that can enhance strategic stability in an increasingly AI-integrated world.

Chinese Perspective

By Qi Haotian

US AND CHINESE ARTIFICIAL INTELLIGENCE CAPABILITIES

All current artificial intelligence (AI) systems fall into the "Narrow AI" category, with machine learning as the most prevalent approach. Machine learning is centered on algorithms that address specific problems in relatively simple environments and scenarios. It is far less capable than "General AI," which, if ever developed, would be able to carry out a broad range of tasks with human-level intelligence. Still, Narrow AI has given rise to substantive advancements and developments in both civilian and military areas. The military applications of AI cut across different levels, from grand strategic and operational processes to tactical and technological performance.

The United States started employing AI to augment its military capabilities decades ago. Around 2010, due to the convergence of big data analytics, improved machine learning, and enhanced computational power, AI entered a period of explosive development that continues today. The Pentagon's unclassified budget for AI development has grown dramatically in recent years, from $600 million in FY 2016 to $2.5 billion in FY 2021, supporting over six hundred active projects.[1]

The Pentagon has initiated a series of big data technology projects that use AI algorithms to acquire and process information from various sources of data, including text, sound, image, and video. If successful, these projects will improve decision-makers' situational awareness, as well as their ability to judge threats and determine courses of action. For instance, Project Maven was set up in 2017 to apply deep learning to actual combat by mining, integrating, and analyzing large amounts of data collected from the Middle East by unmanned aerial vehicle systems.

China has been engaged in an AI-enabled military modernization process that shares many of the features of the structural, doctrinal, and technological transformations of the US military. Whether these dual efforts amount to an "AI arms race" between the two countries remains an open, and largely definitional, question. What is clear is that the two militaries are receiving strong political and financial support, although the economic conditions and budget politics of both countries have created some constraints. China's 2017 Next Generation AI Development Plan describes AI as a "strategic technology" that has become a "new focus of international competition."[2] According to the plan, China will seek to develop a core AI industry worth over 150 billion renminbi by 2020 and to "firmly seize the strategic initiative" and reach "world-leading levels" of AI investment by 2030.[3] China uses a "military-civil fusion" approach—which, as the name suggests, integrates civilian and military resources—to develop capabilities such as autonomous command and control systems, predictive operational planning, and a better fusion of intelligence, surveillance, and reconnaissance (ISR).

Broadly speaking, the People's Liberation Army (PLA) sees the military operationalization of AI and related technologies, including cloud computing, big data analytics, and unmanned systems, as part of the evolution of war from "informatized warfare" (*xinxihua zhanzheng*) toward "intelligentized warfare" (*zhinenghua zhanzheng*).[4] In a 2020 press briefing, Senior Colonel Ren Guoqiang acknowledged that PLA forces have completed mechanization and are working toward informatization.[5] However, other official reports indicate that the PLA is still a long way from establishing robust informatized warfare capabilities.

Both China and the United States are focused on utilizing AI to speed up the process of collecting, integrating, and transmitting data, which can free up human labor for

higher-level tasks such as data analysis. For example, Project Maven seeks to use algorithms to more rapidly analyze imagery from drone surveillance feeds. China is also developing systems with the same purpose. In addition, both militaries are increasingly reliant on algorithms to coordinate command and control, logistics, and weapon systems. For instance, the US Department of Defense's Joint All Domain Command and Control is a concept that relies on various AI-enabled systems to create a centralized flow of information from sensors of all military services.[6] Additionally, the militaries in both countries believe that a more capable command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) system can facilitate planning and decision-making.

ENHANCING STRATEGIC STABILITY IN THE AI REALM: CHALLENGES AND OPPORTUNITIES

As machine learning is still in the nascent stage of development and application, the use of AI brings with it high risks of mistakes and unintended consequences. Military applications of AI thus pose several challenges to strategic stability between China and the United States.

The first challenge comes from the inherent limitations of Narrow AI, which largely relies on high-quality data for training. When training data is limited, artificial neural networks are prone to overfitting and making poor generalizations.[7] In addition, systems trained with specific data sets are susceptible to adversarial attacks, biases, and data manipulation. It is also challenging for current AI systems to adapt to complex and novel environments. Military conflicts, of course, often involve highly complex environments that change rapidly and unpredictably. Faced with such situations, AI systems may run into difficulties assessing and differentiating between different military tactics, such as between a bluff and a real shock-and-awe operation. This shortcoming could lead AI systems to behave unexpectedly in a crisis, escalating tensions further.

A second challenge is that the lack of "explainability" creates uncertainties in human-machine interactions. Most algorithms are still in the "black box" stage, meaning that it is very difficult to fully understand why an AI system has made a particular choice, especially if it behaves unexpectedly. Even if an AI system makes clear choices after successfully adapting to new environments, it is still difficult to trust the system due to the inability to fully examine and understand how it reached these decisions.

The fact that current applications of AI technology can directly threaten nuclear stability presents a third and especially daunting challenge. Advancements in AI give leading nuclear powers such as the United States greater opportunities to limit the deterrence capabilities of other nuclear powers such as China. Rapidly improving capabilities in ISR data collection and analysis, control of autonomous sensor networks, and autonomous target recognition can enable a technologically superior country to not only track but also target a smaller power's nuclear assets. Consequently, the pursuit of such capabilities by stronger nuclear powers could undermine a weaker country's nuclear deterrent. Moreover, concerns that a stronger nuclear power has such abilities could lead to an AI arms race and greater instability. One major point of concern in the AI-nuclear nexus is that nuclear powers do not need to have real AI abilities, just perceived capabilities, to destabilize the strategic balance.

A fourth challenge is that AI may contribute to the blurring of lines between conventional and nuclear operations. This fuzziness is all the more likely to occur given the current military doctrinal transformation led by the United States that focuses on enhancing redundancy, flexibility, and resilience when facing unpredictable challenges in volatile geopolitical environments. For instance, in a strategic crisis, AI technologies could enable conventional weapons to neutralize nuclear assets, including relatively well-protected targets such as hardened intercontinental ballistic missile silos.[8] In the eyes of the attacker, this type of attack neutralizes potential retaliatory capabilities and achieves unilateral deterrence against future strategic interactions. This, in turn, may substantially increase the impetus for the state that has been attacked to use its nuclear assets before those assets are disarmed.

AI's advantage in speed can be detrimental if it unnecessarily accelerates the escalation of conflicts from crisis to war, or even from conventional war to nuclear confrontation. . . . AI, however, can also have a stabilizing effect through the enhancement of crisis and battlefield simulations.

The rapid decision-making features of AI can be yet another destabilizing factor. AI's advantage in speed can be detrimental if it unnecessarily accelerates the escalation of conflicts from crisis to war, or even from conventional war to nuclear confrontation. Furthermore, improvements in ISR capabilities can narrow the window for diplomatic mediation and reduce the time available for crisis management.

AI, however, can also have a stabilizing effect through the enhancement of crisis and battlefield simulations. AI-enabled war games now involve more complex multirole interactions with variables and parameters that can be adjusted to explore how dynamic interactions of various factors such as weapons and allies can influence the development of a complex strategic environment. This employment of evolutionary learning can help stabilize strategic relations and mutual deterrence by demonstrating to decision-makers the consequences of certain behaviors and actions.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

As the United States and China pursue the incorporation of AI into their military forces, they have a shared interest in avoiding both intended and unintended escalations caused by AI-enabled systems. **The two countries should establish systematic confidence-building measures and develop a shared understanding of what a future AI-enabled military transformation might entail as well as its strategic impacts.** While it may be difficult for the United States and China to agree on certain questions—such as how to tailor defense tools for AI systems that span multiple military domains—the two sides can still work together to find common ground and jointly explore applications for AI to strengthen strategic stability.

Although dialogue exists between industry experts, academics, and think tanks in both countries, more direct exchanges among diplomats, military leaders, AI researchers, and multidisciplinary scholars is crucial for fostering mutual understanding and opening avenues for cooperation. Such dialogue can occur in parallel with existing multilateral efforts, such as the Group of Governmental Experts on lethal autonomous weapon systems, held through the United Nations Convention on Certain Conventional Weapons. The two countries should hold dialogues examining how existing international law can constrain the use of AI for military purposes and the implications of private sector development of dual-use technology. They should also address the risks that the weaponization of technology poses to nuclear stability and develop practical measures for technological management. Moreover, the two sides should establish a systematic dialogue mechanism to exchange views on emerging concerns, such as fail-safe mechanisms and how to reduce the risk of crises and conflict escalation due to AI-driven cyberattacks, especially on strategic assets.

In addition to the above near-term measures, there are also some long-term steps that, although not feasible at present, would be beneficial and should be taken when circumstances allow. For example, **China and the United States should increase transparency and enhance mutual understanding by sharing their respective AI strategies, doctrines, and other related documents.** The two should also set limitations on the deployment of AI weapon systems in sensitive areas and exercise restraint in employing AI in strategic command and control systems, particularly with respect to nuclear weapons. Furthermore, they should formulate bilateral or multilateral agreements that prohibit attacks on nuclear C4ISR systems. Finally, they should work to prevent the use of autonomous weapons against other countries' strategic assets, including missile submarines, intercontinental ballistic missiles, and second-strike countermeasure systems.

US Perspective

By Lora Saalman

US AND CHINESE ARTIFICIAL INTELLIGENCE CAPABILITIES

The United States has demonstrated a long-standing interest in employing artificial intelligence (AI) in a variety of mission areas, as evinced in the 2014 Defense Innovation Initiative, among other official documents.[9] These AI applications can be used to enhance automated target recognition systems; autonomous navigation systems for missiles, unmanned combat vehicles, and swarms; intelligence, surveillance, and reconnaissance (ISR) data processing; and automated cyber defense and offense. Importantly, machine learning can be used to improve the guidance capabilities of delivery systems, detection capabilities of early-warning systems, intercept by missile defenses, and maintenance of nuclear assets—having a direct or indirect impact on both conventional and nuclear force modernization and, thereby, on strategic stability.

Despite these applications, open source material on the integration of AI in military capabilities, especially US nuclear forces, remains limited. The 2018 Nuclear Posture Review makes no direct reference to AI applications in nuclear forces, other than a brief reference to Russia's alleged development of the nuclear-armed Poseidon unmanned underwater vehicle (UUV).[10] Still, some discussions about the nuclear role of AI can be found in the public domain. For example, in spite of some US government officials expressing opposition to AI integration into nuclear command, control, and communications (NC3) systems, reports indicate that the B-21 Raider strategic bomber could be "optionally-manned," thereby requiring a degree of AI and autonomy.[11] Such potentialities, even if not realized, have a strong impact on countries such as China and Russia that may be exploring similar advances.

Although a more recent entrant, China has set its sights on becoming an AI leader—driven in part through "military-civil fusion" and an array of AI-focused public and private sector entities.[12] China's 2017 New Generation Artificial Intelligence Development Plan does not set a concrete role for AI in future warfare, yet it focuses on a wide range of core capabilities that could enable conventional and nuclear force advances.[13] These include computational military reasoning, intelligent and autonomous weapon systems, information processing and intelligence analysis, cyber defense and cyberwarfare, and electronic warfare. These are relevant for China's concept of "rapid response," which emphasizes prompt and precise response to attacks.

Although China's 2019 defense white paper, "China's National Defense in the New Era," does not detail AI impacts on nuclear forces, China has been modernizing its nuclear arsenal with advances in submarine-launched ballistic missiles (SLBMs) and multiple independently targetable reentry vehicles, which could benefit from AI enhancement in terms of deployment, targeting, and concealment.[14] China is also engaged in discussions and research on "launch on warning," integration of greater autonomy into cruise missiles, and a range of aerial and underwater unmanned systems, as well as improved maneuverability of its hypersonic glide vehicles that may be eligible for future nuclear delivery.[15]

ENHANCING STRATEGIC STABILITY IN THE AI REALM: CHALLENGES AND OPPORTUNITIES

AI has the potential to both stabilize and destabilize the US-China strategic relationship through its impact on at least four areas: early warning and ISR; tracking and delivery; cyber defense and offense; and verification and transparency.

A demonstration flight of a drone made by Shield AI, a private company based in San Diego, California, on November 11, 2020. (Photo by John Francis Peters/New York Times)

In terms of *early warning and ISR*, AI can enable faster and more comprehensive tools that enhance nuclear decision-makers' situational awareness and allow them to make better informed time-critical decisions. For example, some US officials have discussed using Project Maven—which applies machine-learning to sort through masses of ISR data—in the Air Force's Advanced Battle Management System to promote joint command and control across all five warfighting domains: air, land, sea, space, and cyberspace.[16] For countries such as China that have concerns over a prompt and precise conventional strike against their nuclear forces and NC3, the ability to improve monitoring and reaction times is also compelling. Chinese experts express particular concern over AI-enabled remote-sensing systems on autonomous surface or underwater vehicles weakening deterrence at sea.[17]

Although naval warfare experts tend to regard this view with skepticism, unmanned systems could be deployed to monitor chokepoints that an adversary's ballistic missile nuclear submarine traverses to reach or exit its patrol zone.[18] The increased deployment of unmanned systems with ambiguous payloads could also result in both intentional and unintentional collision and escalation, further lowering the US-China conflict threshold. Beyond sea-based concerns, machine learning can also strengthen space-based remote sensing use of predictive analytics to anticipate movements of road-mobile intercontinental ballistic missiles (ICBMs) and other transports.[19] China, which is highly dependent upon these maneuvers to protect its delivery platforms, is concerned about the adverse impact of AI-enhanced surveillance on its nuclear survivability and second-strike capabilities.

As regards *tracking and delivery*, AI can improve the detecting, selecting, targeting, and intercepting functionality of unmanned systems and missile defense. Unmanned vehicles can be deployed as decoys to complement air defenses, as well as to engage in anti-access/area-denial maneuvers. Countermeasures, however, can also compel the use of more survivable but less controllable nuclear delivery platforms, including unmanned combat aerial vehicles (UCAVs), hypersonic glide vehicles, and UUVs. While enhancing maneuverability and survivability, extended unmanned sorties in communications-denied environments carry risks of loss or malfunction. Nonetheless, China has shown an interest in such unmanned platforms. Although China maintains ambiguity as to whether the payloads will be conventional or nuclear, China has long sought to maintain its second-strike capabilities in response to US missile defense and conventional prompt global strike.[20] Furthermore, AI already factors into the Aegis Ballistic Missile Defense System's use of active radar seekers, enhancing the ability of these land- and sea-based systems to intercept ballistic missiles.[21] Concerns over such systems contribute to Chinese decision-making on the commingling of nuclear and conventional systems and NC3 to deter attacks.[22] These programs have also entrenched Chinese views on US threats to their nuclear survivability. However, this action-reaction cycle also works in reverse. US interest in low-yield SLBMs and low-yield submarine-launched cruise missiles has been widely interpreted as a reaction to Russia, but such pursuits could be amplified by concerns that China may pursue nuclear delivery platforms similar to Russia's Poseidon UUV.

AI's role in *cyber defense and offense* includes enhancement of virtual simulations, providing decision-makers with new tools to predict and confront crises. Machine learning also has applications in nuclear safety and security, because it can be used to engage in predictive maintenance, while autonomy can be used in continuous system surveillance. AI protection against cyberattack, physical attack, and system failure also notably extends to NC3. However, these qualities can undermine these same nuclear systems. Of particular interest in China is how machine learning can enable "left-of-launch" operations to defeat the threat of an ICBM before it is launched.[23] As with cyberwarfare, machine learning can also improve electronic warfare, with new jamming tools that could benefit left of launch. On information warfare, machine learning offers new ways to manipulate decision-makers, such as through the use of generative adversarial networks (GANs) that can create fake orders or through ISR data poisoning.[24] Given the charged US-China history on cyber operations, these left-of-launch and NC3 threats only further complicate trust building and deterrence calculations.

AI-enabled systems for early warning and ISR can be used by the international community to enhance *verification and transparency* in monitoring nuclear developments and arms control treaty compliance. However, the amorphous quality of AI can also complicate these efforts, exacerbating concerns over AI "haves" versus "have-nots" and an AI capabilities race that extends beyond China and the United States to other nuclear-armed countries. For China, the cascade effect of competition already emerged following the US release of its 2014 Defense Innovation Initiative and 2010 and 2018 Nuclear Posture Reviews. As China and the United States proceed with AI military integration and modernization of their nuclear arsenals, greater automation of nuclear launch policies may result from concerns over technological asymmetries. Thus, while AI may not decisively push China to implement launch on warning or to relinquish its "no-first-use" posture, machine learning and autonomy could accelerate such trends.

CONCRETE STEPS TO TAKE IN THE NEAR TERM

On *early warning and ISR*, US-China maritime dialogues should include experts with a technical background in machine learning and autonomy to deepen discussions on what unmanned systems are able and, more importantly, unable to do in terms of the physics of water conductivity and deployment. Furthermore, these talks

should feature those with military operational experience to explore confidence-building measures to address both intentional and unintentional collision and escalation. On road-mobile ICBM transports, which are of critical importance to China, the ability to engage on the impact of AI-enhanced surveillance is limited, yet could be factored into the strategic stability dialogues described below.

On *tracking and delivery*, US-China strategic stability dialogues should include officials who can address machine learning and autonomy in unmanned systems and the importance of retaining human control over NC3. As part of these talks, both countries could issue parallel official documents or statements outlining norms and standards in the application of AI in nuclear policy. Such dialogues would also benefit from targeted sessions that explore the impact of UCAVs, hypersonic glide vehicles, and UUVs on second-strike capabilities and the commingling of conventional and nuclear payloads. Finally, since these trends are interrelated, it would also be beneficial to eventually include Russia, whether in a trilateral configuration or a multilateral format under the auspices of such groups as the First Committee of the UN General Assembly.

On *cyber defense and offense*, US-China cyber dialogues should include experts with a technical background in cyber and nuclear fields for a more realistic assessment of the positive and negative applications of AI in nuclear-related cyber defense and offense. These discussions could also feature officials and operators who possess a practical understanding of NC3 to discuss the implications of GANs and fake orders on the decision-making chain. Finally, for a more concrete understanding of left-of-launch and NC3 threats, while political scientists may be part of the discussion, they should not be central to it.

On *verification and transparency*, US-China forensic dialogues should include experts on nuclear forensics and AI applications to better explore and address the overlap of these two fields and to better formalize interactions between, for instance, China's State Nuclear Security Technology Center, the Verification Research, Training, and Information Center, and the Nuclear Threat Initiative. Furthermore, such joint projects and tabletop exercises should focus on generic cases and applications of forensics and monitoring, so as to allow for greater objectivity and latitude to engage. Finally, these discussions could also be multiparty to include other countries and nongovernmental organizations to address concerns associated with AI haves and have-nots.

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Notes

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The views expressed in the essay by Brad Roberts are the author's personal views and should not be attributed to his employer, the Lawrence Livermore National Laboratory, or any of its sponsors.

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