Conventional Challenges to Strategic Stability:

Chinese Perception of Hypersonic Technology and the Security Dilemma

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China used to understand strategic stability as a comprehensive concept that describes the overall stability of a bilateral relationship and that is affected by a wide range of factors – military, political, diplomatic, and economic.[1] In recent decades, Western literature on nuclear and deterrence started to be introduced to and embraced by Chinese strategic community. As a result, Chinese experts are increasingly using this term to refer to a bilateral nuclear relationship of mutual vulnerability.[2] Maintaining such mutual vulnerability relationship with other major nuclear powers, especially the United States, is of ultimate importance to Chinese decision-makers. However, despite Beijing's efforts to enhance its nuclear retaliation capability through modernization programs, it sees itself facing significant new challenges.

The emergence of advanced conventional weapons is widely recognized as one of the major challenges to strategic stability in the so-called "second nuclear age". Such conventional weapons can travel at extremely high speed and strike targets with extraordinary accuracy, and thus offer unique military opportunities. Among all conventional military capabilities, hypersonic weapons that are under development can potentially travel long distances at speeds of more than Mach 5 and have much greater capability to change flight trajectory than ballistic missiles. This emerging conventional military technology is potentially capable of disrupting mutual vulnerability relationships between nuclear powers by blurring the lines between conventional and nuclear warfare.[3]

The United States has the most advanced hypersonic technology development program and has expressed interest in deploying such weapons. According to the Obama Administration's 2010

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[1] Jin Wang and Wensheng Li, "The Contraversies over the Two Plus Two: The Missile Defense and Strategic Weapons of the Untied States and Russia ("2+2"的"是非题" 美俄反导及战略武器)," *Ordnance Knowledge*, no. 5 (2008); Nengwu (徐能武) Xu, "The Threats and Challenges to Outer Space Security Posed by the Adjustment of the U.S.Strategic Deterrent System (美国战略威慑体系调整对外层空间安全的潜在威胁与挑战)," *National Defense Science & Technology*, no. 2 (2013).

[2] Xiangli (孙向丽) Sun, "Theories and Practice in Arms Control (军备控制的理论与实践)," *Teaching and Research (*教学与研究*)*, no. 6 (2001); Jingping (李静平) Li, "A Preliminary Analysis on U.S.-China Strategic Stability: Contructing U.S.-China Strategic Stability Beyond Strategic Weapons (中美战略稳定初探——超越战略武器看中美战略稳定的构建)," in *13th PIIC Beijing Seminar on International Security* (Beijing: Program for Science and National Security Studies (PSNSS), 2012).

[3] Gregory D Koblentz, *Strategic Stability in the Second Nuclear Age* (Council on Foreign Relations, 2014); Barry D. Watts, "Nuclear-Conventional Firebreaks and the Nuclear Taboo," (Washington DC: Center for Strategic and Budgetary Assessments, 2013).

Nuclear Posture Review Report, for instance, conventional weapons would play a more important role in the U.S. deterrence posture.[4] The U.S. investment into the development of hypersonic weapons is causing major Chinese concerns.

Chinese experts have a very broad understanding of the definitions and scope of advanced U.S. conventional prompt strike weapons.[5] From the Chinese perspective, such weapons not only include the cutting-edge U.S. Conventional Prompt Global Strike (CPGS) weapons such as boost-glider vehicles, but other conventional weapons that are perceived as having strategic military significance, such as the planned new strategic bomber B-21 (with an estimated cruise speed of Mach 4), space-based kinetic bombardment projectiles, and even high-speed unmanned aerial vehicles.[6] That said, generally speaking, when talking about "U.S. hypersonic weapons," Chinese experts and analysts include the following weapons in their discussion: boost-glide systems, hypersonic cruise missiles (that use ramjets), unmanned spacecraft such as the X-37, and sometimes conventional ballistic missiles.[7]

Chinese analysts are not convinced by U.S. claims that its Conventional Prompt Global Strike capabilities will not and are not intended to threaten Russian or Chinese nuclear forces. They believe that hypersonic weapons pose a potentially grave threat to China's small nuclear arsenal by making Washington capable of preemptively striking Beijing's nuclear forces without using nuclear weapons. Therefore they believe that China has to take significant measures to bolster its nuclear deterrent in response to such new threat. In addition to countermeasures, China has also started its own hypersonic technology research and development program, primarily to better understand the full potential of the technology. This "competition" over hypersonic technology has the potential to significantly disrupt existing nuclear balance and undermine our traditional understanding of strategic stability between major nuclear powers like the United States and China. Furthermore, Beijing's efforts to follow Washington's example in developing hypersonic technology are then causing U.S. suspicion about China's intentions. Many in Washington see China's growing hypersonic capability as a new military threat and believe the United States

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[4] "Nuclear Posture Review Report," (Washington DC: US Dept of Defense, Office of the Secretary, United States of America, 2010).

[5] Lora Saalman, "Prompt Global Strike: China and the Spear," (Honolulu, HI: Asia-Pacific Center for Security Studies, April 2014).

[6] Yong (赵永) Zhao et al., "Us Global Prompt Strike System Development Status and Trend Analysis (美国全球快速打击系统发展现状及动向分析)," *Cruise Missile (*飞航导弹*)* 1, no. 3 (2014).

[7] Haitao (罗海涛) Luo, "Foreign Media Pays Attention to China's Hypersonic Aircraft (外媒关注中国高超音速飞行器)," 2015-07-07; Yi (梁熠) Liang et al., "Analysis of Us Prompt Global Strike Equipment Development美军快速全球打击装备发展分析)," *Journal of the People's Liberation Army Academy of Equipment Command & Technology (*装备指挥技术学院学报*)* 25, no. 5 (2014); Hui (武卉) Wu and Wen (牛文) Niu, "Us Actively Developing Hypersonic Weapons (美国积极发展高超声速武器)," *Cruise Missile (*飞航导弹*)* 8, no. 8 (2014); Yong (方勇) Fang, "U.S. Pushes Forward with Prompt Global Strike Program (美国推进快速全球打击计划)," *New Age Defense (*新时代国防*)* 8 (2010); Aiguo (党爱国) Dang, Yanpeng (郭彦朋) Guo, and Kun (王坤) Wang, "Foreign Hypersonic Weapons Development Review (国外高超声速武器发展综述)," *Cruise Missile (*飞航导弹*)* 2, no. 2 (2013).

should take measures to counter such threat.[8] Such action-reaction dynamic is fueled by lack of accurate understanding about the nature of and motivation behind each other's programs and contributes to existing security dilemma.

This chapter draws directly on Chinese literature to understand the following questions: what are China's specific concerns about hypersonic weapons? How do Chinese experts expect hypersonic technologies will change future nuclear relationships and therefore affect traditional understandings of strategic stability? And what are the major mismatched perceptions in both countries about each other's hypersonic technology development and what does this mean for maintaining U.S.-China strategic stability in the future?

Chinese Understanding of the Definition and Scope of Hypersonic Weapons

The scholarly and policy communities in China have used different terms to refer to advanced conventional weapons similar to those being developed under the U.S. Conventional Prompt Global Strike (CPGS) program. Such terms include, for instance, "hypersonic weapons" (高超音速武器), "global strike" weapons (全球打击武器), "prompt strike" weapons (快速打击武器), "precision strike" or "precision guided" weapons (精确打击武器/精确制导武器), among others. These terms are often used interchangeably by different experts without clearly defining what they specifically refer to. But a closer look reveals that different terms do sometimes tend to highlight different characteristics of weapons. For example, "hypersonic weapons" and "prompt strike" weapons highlight the high-speed of such weapons; "global strike" weapons emphasize the capability of such weapons to strike long-range targets – usually within a very short time; and "precision strike" or "precision guided" weapons underscore the high accuracy of such weapons.

This research compares the usage of these terms in documents contained in the China Knowledge Resource Integrated Database (CNKI), the most inclusive collection of open-source Chinese publications. It includes all major Chinese journals, newspapers, university theses and dissertations, conference papers, magazines, government reports, and more. When it comes to security studies, this database provides access to almost all openly published articles written by Chinese civilian scholars, military experts, and scientists in the defense industry. These articles provide a representative view of the Chinese strategic community on issues such as nuclear weapons, deterrent, CPGS, missile defense, and more. Table 1 shows the number of publications for the above-mentioned search terms between the years 1949 and 2015, and Figure 1 provides a yearly breakdown of these publications between 1975 and 2015. It appears that Chinese experts have used the term "precision strike" (or "precision guided" and "precision guidance") much more frequently than other terms. However, a deeper look at these publications reveal that even though Chinese experts do sometimes use this term to refer to CPGS weapons, this term is much more often used to refer to much less capable weapons that have been broadly defined as "precision" weapons. These include weapons like precision-guided artillery shells, subsonic cruise missiles, and guided gravity bombs, but they bear no resemblance with the cutting-edge CPGS technology. Rather, "hypersonic weapon" (or hypersonic technology") is the most used

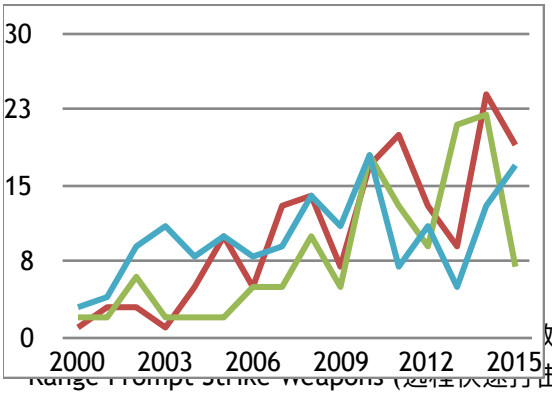
[8] "Howard P. "Buck" Mckeon National Defense Authorization Act for Fiscal Year 2015: Report of the Committee on Armed Services House of Representatives on H.R. 4435," http://www.lasg.org/budget/HRPT-113-OJCR-HR4435.pdf.

term for CPGS type of weapons. This research therefore focuses on the "hypersonic weapon" (or hypersonic technology") literature and conducts an in-depth content analysis of such publications.

Figure 1 also reveals that the Chinese level of interest in hypersonic weapons corresponds largely with U.S. discussion and investment into its CPGS program. The level of interest picked up significantly after 2003 when the Bush administration instructed the Strategic Command to draft plans for carrying out "global prompt strike" operations.[9] Chinese interest has continued to grow into the present, which underscores that this issue is of increasing importance to the Chinese strategic community. (The 2015 figure is an estimation of the entire year based on data from the first seven months.)

Table 1 Number of Publications for Different Search Terms (1949-2015)

Search Term (search by keyword in title)	**Number of publications**
"hypersonic technology" OR "hypersonic weapon" (高超音速武器 OR 高超音速技术)	1,805
"global strike" (全球打击)	158
"prompt strike" (快速打击)	137
"precision strike" OR "precision guided" OR "precision guidance" (精确打击 OR 精确制导)	4,977
("precision strike" OR "precision guided" OR "precision guidance") AND "conventional" ((精确打击 OR 精确制导) AND 常规)	192



敏民) Huang, "Status of Research and Impact of Long-Range Prompt Strike Weapons (远程快速打击武器的研究现状和影响)," *Defense Technology (*国防科技*)* 1 (2013).

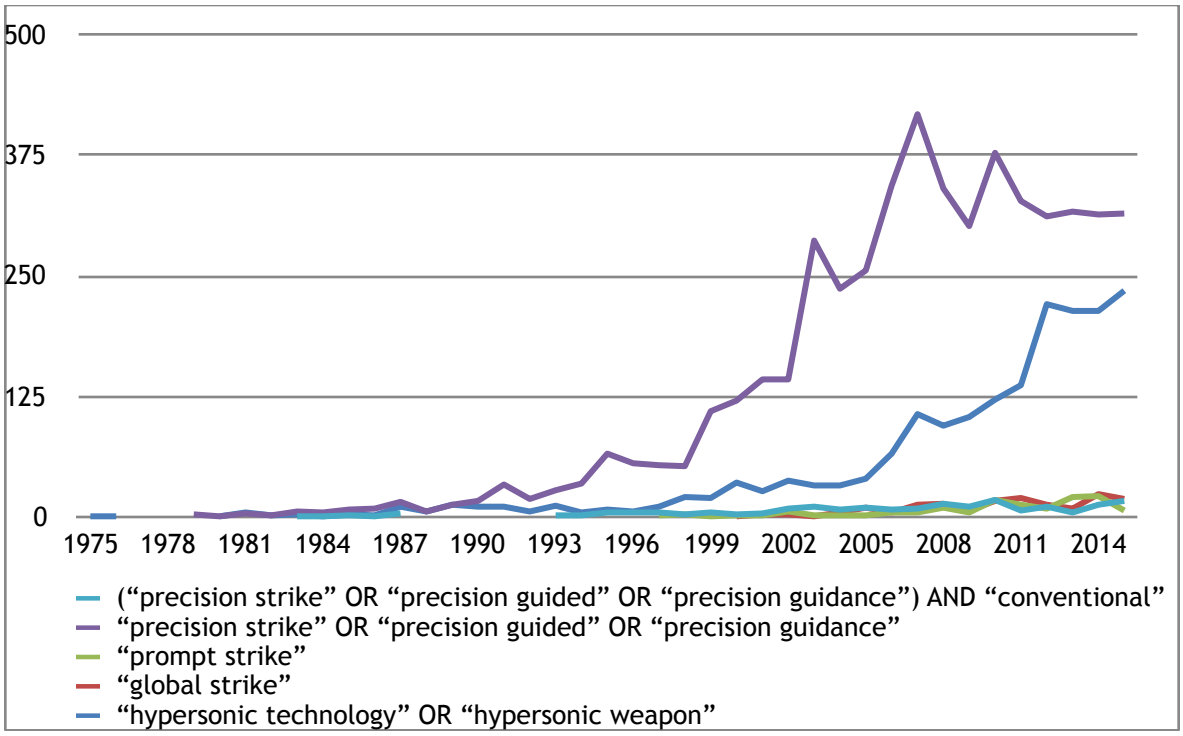


Figure 1 Yearly Publication for Different Search Terms (1975-2015)

There is general consensus among Chinese experts that "hypersonic" means a speed at or higher than five times the speed of sound (Mach 5).[10] Some Chinese experts put hypersonic weapons into two categories: one is hypersonic vehicles and the other is the so-called "high-speed kinetic-energy weapons".[11] Hypersonic vehicles include boost-glide weapons, hypersonic cruise missiles, and unmanned spacecraft like the X-37B. The term "high-speed kinetic-energy weapon" refers to systems like the railgun, which can accelerate an armature to a muzzle speed of over Mach 5 and uses this high kinetic energy to destroy targets directly. Because hypersonic vehicles receive the most attention from Chinese experts, this research focuses the discussion only on hypersonic vehicles.

Chinese Understanding of the Advantages of Hypersonic Weapons

Penetrating Capability

The ability to penetrate defensive systems is considered the most important feature of hypersonic weapons. The vast majority of Chinese experts believe that hypersonic weapons cannot be defended against. The main reasons they raise include the following:

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[10] Feng (高峰) Gao, "Hypersonic Weapons Open New Warfare Situations (高超音速武器开启战争新态势)," *Science 24 hours (*科学 *24* 小时*)*, no. 5 (2015).

[11] Ibid. Note that some hypersonic vehicles such as boost-gliders can also destroy targets just through their kinetic energy, and therefore they can also be called high-speed kinetic-energy weapons, technically speaking. The quoted Chinese expert is using the term "high-speed kinetic-energy weapon" to refer mostly to the railgun weapon.

First, hypersonic weapons are difficult to track. Although some Chinese experts state that hypersonic weapons are very difficult to detect because of their high speed and capability to carry electronic countermeasure equipment,[12] most Chinese experts argue that detection of such weapons will not be a problem. On the contrary, they recognize that hypersonic weapons are short on stealthiness.[13] The real problem, they believe, is that it will be difficult to keep track of such weapons during flight.[14] For instance, one Chinese expert explains that all current missile and air defense systems, including those of both the United States and Russia, "would appear powerless when facing hypersonic weapons. Because all these defensive systems are designed for targets that have predictable flight trajectories, whereas the advantage of hypersonic weapon is its high speed, high altitude, and high maneuverability of flight trajectory. All existing normal early warning and air defense radars will be useless; let alone those mechanical scanning radars which are even less capable of detecting and tracking such targets."[15] One article in the PLA Daily points out, it will be hard to predict the trajectory and landing point of a hypersonic weapon: "Even if the sensors of a defensive system can detect the launch of such a weapon, they cannot track it on a continuous basis." Such difficulty to predict the trajectory and landing point of a hypersonic weapon "means the inability to obtain accurate data (for interception)." As a result, hypersonic weapons would "have a very high rate of penetration against ballistic missile defense systems."[16]

Second, it is difficult to respond quickly to a hypersonic weapon attack. In addition to the difficulty to track hypersonic weapons, Chinese experts recognize that for most of the countries that do not have a global early warning system (which includes China), defending against a hypersonic strike is very challenging. Experts from the Chinese defense industry write that, as a country with limited early warning capability, it only has about 3 minutes' warning time before a hypersonic weapon traveling at Mach 10 and at an altitude of 20km would be able to strike a target on its territory. If the hypersonic weapon travels at Mach 6 and at an altitude of 100km, Chinese officials still only have 11 minutes to act.[17] Such short warning time will not be enough

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[12] Jie (刘杰) Liu, Feng (何峰) He, and Jing (吴静) Wu, "Analysis of Developing Trend of Defending against Hypersonic Targets in Future Air Defense and Anti-Missile Operations (未来防空反导作战中高超声速目标的发展趋势分析)," *Cruise Missile (*飞航导弹*)* 1, no. 4 (2014).

[13] Wei (勇伟) Yong, Zemin (吴泽民) Wu, and Xiao (付晓) Fu, "High-Speed Killer Hidden in the Upper Air (隐匿于高空中的极速杀手)," 2014-09-13.

[14] Yi (木易) Mu, "China and Us Compet in Developing Hypersonic Missile; Global Anti-Missile Systems May Be Useless (中美争研高超音速导弹 全球反导系统恐将作废)," *Life and Disasters (*生命与灾害*)*, no. 10 (2014).

[15] Zhuoqian (王卓谦) Wang, "Hypersonic Leading the New Trend in Aerospace Flight (高超音速引领空天飞行新趋势)," 2014-08-30.

[16] Yong, Wu, and Fu, "High-Speed Killer Hidden in the Upper Air (隐匿于高空中的极速杀手)."

[17] Shuyan (李淑艳) Li et al., "Near Space Hypersonic Weapon Defense Review (临近空间高超音速武器防御综述)," *Modern Radar (*现代雷达*)* 36, no. 6 (2014).

for a defensive system to process relevant information and prepare an appropriate response, after receiving an interception order.[18]

Third, hypersonic weapons are difficult to intercept. The majority of Chinese scholars believe that hypersonic technology is capable of effectively penetrating "terminal phase missile defense systems."[19] The combination of such weapon's high speed and high maneuverability is perceived to give it a great advantage over terminal phase interceptors.[20] Chinese experts claim that even future missile defense technologies like laser interceptors will not be able to destroy hypersonic weapons. The outer casing of hypersonic weapons needs to endure the high temperature and high pressure as a result of its high traveling speed, and thus has to be made very firm and strong. It therefore "won't be burned out even if it is shot at by high-power laser beam."[21] For all the above reasons, the vast majority of Chinese experts conclude that hypersonic weapons "are the demolisher of anti-missile systems."[22]

With that said, some Chinese experts are not convinced that hypersonic weapons cannot be defended against. In their view, hypersonic weapons will be easy to detect and destroy for several reasons. For instance, in order to achieve high cruise speed and long travel range, hypersonic cruise missiles usually fly at higher altitudes than ordinary cruise missiles. Such high altitudes make them easier to detect through early warning radar and airborne early warning aircraft. According to Wang Jixin from the People's Liberation Army Academy of Equipment Command & Technology, even for ground-based X-band radar, it can detect X-51 type of hypersonic cruise missile that flies at an altitude of 40km at a distance of 800km, which would allow enough time for land-based interceptors to respond.[23] In addition, hypersonic weapons will possess significant radar and infrared signal characteristics. The radar cross-section for weapons traveling at Mach 2-3 is more than ten times larger than that of sub-sonic weapons; and its infrared signal strength could be 20-50 times greater than sub-sonic weapons, in the wavelength range of 3-5 microns.[24]

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[18] Gao, "Hypersonic Weapons Open New Warfare Situations (高超音速武器开启战争新态势)."; 李淑艳 et al., "临近空间高超音速武器防御综述," 现代雷达 36, no. 6 (2014).

[19] Li (贾利) Jia, "Russian Air and Space Forces Ready to Go (俄罗斯空天军蓄势待发)," 2015-04-28.

[20] Gao, "Hypersonic Weapons Open New Warfare Situations (高超音速武器开启战争新态势)."; Wenlong (胡文龙) Hu, "Air-Space Integrated Hypersonic Attack - the Upcoming New Round of Warfare Revolution (空天化高超音速攻击——即将来临的新一轮战争变革)," *Defense Technology (*国防科技*)* 36, no. 2 (2015).

[21] Liang (张良) Zhang, "Hypersonic Weapons That Will Change the Rule of Future Warfare (改变未来战争规则的高超音速武器)," *Life and Disasters (*生命与灾害*)* 5 (2014).

[22] Ruiliang (王瑞良) Wang, "Hypersonic Missiles for the Future (为未来而来的高超音速导弹)," *Science 24 hours (*科学 *24* 小时*)*, no. 7 (2014).

[23] Jixin (王继新) Wang, "Introducing Hypersonic Weapons (高超音速武器漫谈)," *Ordnance Knowledge (*兵器知识*)*, no. 5 (2014).

[24] Ibid.

Together, these facts suggest to some Chinese experts that hypersonic weapons will be easily detectable, and thus may be potentially vulnerable to existing defense systems (after upgrade).

Wang also doubts how maneuverable hypersonic weapons can be in reality. When an aircraft swerves, the turning radius is proportional to the square of its speed. Therefore, because hypersonic weapons travel at extremely high speed, its normal acceleration overload would be very high too. This high normal acceleration overload would not only increase aerodynamic drag but also require the weapon to have a particularly strong mechanical structure. It appears, then, that the weapon's defining feature – its high speed – could also undermine its maneuverability vis-à-vis interceptors.[25] Tang Zhicheng, a professor and senior colonel from the Second Artillery Command College, also claims that "the conclusion that hypersonic weapons cannot be intercepted is based on a set of specific assumptions."[26] In his view, the greatest significance of hypersonic weapons is that they can effectively penetrate terminal phase anti-missile systems—and nothing more. They are almost equally vulnerable during the boost phase and mid-course of their flight.

These experts believe that weapon manufacturers can further develop existing ballistic missile defense systems to create systems capable of defending against hypersonic weapons. For this matter, they use some existing U.S. missile defense systems as examples. They point out that the speed of interceptor, the lower limit of interception altitude, and the interception range can be reasonably extended for existing anti-missile systems such as the Terminal High Altitude Area Defense (THAAD) and SM-3 to make them capable of dealing with hypersonic weapons.[27]

Despite of the fact that SM-3 is not a terminal phase missile defense system, many Chinese experts indicate that hypersonic weapons are less vulnerable to terminal phase missile defense systems than to other missile defense systems. This is different from the assessment of some experts in the United States who point out that "point defense" rather than "area defense" is more likely to be achieved against CPGS weapons,[28] where terminal phase missile defense is generally regarded as a "point defense" system. It is necessary to note that, the Chinese assessment is provided in very general terms and the ultimate effectiveness of any defensive system in practice is influenced very much by specific technical factors such as capability of the tracking radar, the relative maneuverability of the striking vehicle vis-à-vis the interceptor, the speed of the striking vehicle during the terminal phase, which is then determined by the type of intended targets,[29] among other things. Chinese and Western analysts seem to have different assumptions over these technical factors, which may have led to the gap between some Chinese and Western assessments.

Standoff Capability and Crisis Signaling

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[25] Ibid.

[26] Zhicheng (汤志成) Tang, "Hypersonic Weapon Can Not Be Intercepted Is Pseudo-Proposition (高超音速武器无法被拦截是伪命题)," *Ordnance Knowledge (*兵器知识*)*, no. 02 (2015).

[27] Wang, "Introducing Hypersonic Weapons (高超音速武器漫谈)."

[28] James M Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike* (Carnegie Endowment for International Peace, 2013).

[29] Ibid.

Chinese experts also consider hypersonic weapons' capability to launch strikes far away from the target country's territory a very important feature. The Hypersonic Technology Vehicle 2 (HTV-2) is planned to have a strike range of about 17,000 km, which could reach China if launched from the continental United States.[30] Even shorter-range systems like the Advanced Hypersonic Weapon (AHW), which has a planned range of about 8,000 km and a tested range of over 3,800 km, can reach targets deep in China when launched from Guam.[31] These standoff capabilities have important implications for China because the United States would no longer need to use vulnerable military platforms such as bombers to put China's nuclear and strategic targets at risk. Several American scholars have noted that bombers could play an important role in conducting counterforce strikes against Chinese nuclear forces.[32] But they will no longer be needed after hypersonic weapons become operational. According to Chinese experts, "the emergence of hypersonic weapons has completely removed the boundary between the frontline and the rear area"; "the strategic rear area will become the frontline."[33] Under these new conditions, "national leaders, strategic command and control centers, nuclear weapons bases, aerospace launch facilities, and critical economic infrastructures" will be on the target list of an enemy first strike by hypersonic weapons. The consequences of which will not only alter military balances but also have a psychological impact on decision-makers during crisis: "These targets will become extremely vulnerable", and this will "dramatically increase the psychological pressure of the national leadership, which will for sure affect decision-making and will bring about significant change to the way war will be fought and won."[34] The long-range standoff capability of American hypersonic weapons will make the United States less dependent on forward deployment of shorter-range weapons. This will, as some Chinese experts argue, give the United States the "freedom of maneuver in the global commons", and "to extricate the United States from its dependence on use of foreign military bases and foreign territorial land, air, and sea."[35]

In a crisis scenario, some characteristics of hypersonic weapons are seen as potentially useful for signaling purposes. Scholars from the Air Force Engineering University suggest that some hypersonic weapons have a significant part of their flight trajectories in near space, which is not part of any country's territory. As a result, during a crisis, a country could feasibly launch a test flight of such weapons that can travel above an enemy's territory without violating international

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[30] "U.S. Conventional Prompt Global Strike: Issues for 2008 and Beyond," (Washington DC: Committe on Conventional Prompt Global Strike Capability, Naval Studies Board, Division on Engineering and Physical Sciences, National Research Council of the National Academies, 2008).

[31] Ibid.; *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike*.

[32] Keir A Lieber and Daryl G Press, "U.S. Nuclear Primacy and the Future of the Chinese Deterrent," *China Security*, no. Winter (2007).

[33] Hu, "Air-Space Integrated Hypersonic Attack - the Upcoming New Round of Warfare Revolution (空天化高超音速攻击——即将来临的新一轮战争变革)."

[34] Ibid.

[35] Ibid.

laws. As they suggest, this can send a very strong signal and may cause maximum deterrence impact in the mind of the enemy.[36]

However it might be necessary to note that this is not unique to hypersonic weapons. One can also use a ballistic missile to shoot over another country's territory. The most part of a long-range ballistic missile would be in outer space and therefore in theory would not violate that country's sovereignty. But the psychological impact of such a signaling activity may be too strong to make consequence management possible. For example, the North Korean testing launch of its Daepodong missile which flew over Japan and landed in the Pacific ocean in 1998 (and which was not intended as a signal to Japan) has made Japan so concerned that Japan dramatically ramped up its missile defense capability and has been prepared to intercept following North Korean missile tests that might again fly over or close to Japan.[37] Furthermore, hypersonic weapons are fundamentally different from ballistic missiles because their trajectories can change during flight and therefore are much less predictable. This makes hypersonic weapon a really problematic instrument for signaling purposes. Because the enemy may not be able to tell whether itself is the intended target of a hypersonic weapon by simply monitoring the flight, it may be inclined to act according to the worst-case scenario and assume itself is under attack. A signaling activity could therefore easily end up provoking an inadvertent military conflict. The danger will be even greater if the enemy possesses nuclear weapons and cannot distinguish a conventionally-armed hypersonic weapon from a nuclear-armed one. It may think that it is under nuclear attack and therefore decide to release its own nuclear weapons as retaliation. For such reasons, hypersonic weapons can cause crisis instability in ways that have not been carefully examined. The proposition that they may be used for crisis signaling purposes needs to be thoroughly examined and debated.

"Niche" Capability vs. Massive Deployment

Some Chinese writers believe hypersonic weapons are more cost-effective than other alternative conventional strategic strike systems. For instance, conventional hypersonic weapons are seen as less expensive than conventional long-range ballistic missiles which are too expensive to be built and used in large numbers. Short-range conventional tactical missiles are more affordable than big long-range conventional ballistic missiles, but such weapons need forward bases to be deployed; this raises their overall cost. In comparison, conventional hypersonic weapons are perceived to be as affordable as ordinary conventional cruise missiles but at the same time are as swift and responsive as long-range ballistic missiles.[38] One technical reason they mentioned for the relative low cost is that the scramjet engine used in hypersonic cruise missile has a less

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[36] Xu (刘旭) Liu et al., "Thoughts on Hypersonic Cruise Missile Combat Characteristics and Offense-Defense Model (高超声速巡航导弹作战特点及攻防模式思考)," *Cruise Missile (*飞航导弹*)*, no. 9 (2014).

[37] Nobuhiro Kubo, "Japan to Intercept Any North Korea Missile Deemed a Threat," The Reuters, http://www.reuters.com/article/us-japan-korea-missiles-idUSBREA3404I20140405.

[38] Huaiyu (汤怀宇) Tang, "Military Significance of China's Hypersonic Weapons (中国高超音速武器的军事意义)," *Defense Times (*国防时报*)* April 16, 2014.

complex structure than traditional jet engine and thus costs less to manufacture.[39] Addition to boost-glider and hypersonic cruise missile, unmanned spacecraft like the X-37 is seen as a very cost-effective technology for conducting rapid-response military operations in space because the spacecraft can be used repeatedly.[40] Therefore, as military analyst Gao Feng points out, the overall cost of hypersonic weapons is sufficiently low for it to "become the inevitable choice of military powers".[41]

This Chinese assessment—that hypersonic weapons are cost effective—contradicts the mainstream U.S. assessment. American experts believe that CPGS would be so expensive that they could only be deployed in very small numbers and become only a "niche capability."[42] As James Acton points out, the U.S. assessment of hypersonic weapons has yet to include critical "enabling capabilities" that are necessary for the deployment of such weapons but may further increase the overall cost of such weapons significantly.[43] This same appears to be true for Chinese assessment as well. Public discussions in China about hypersonic weapons have not looked extensively at necessary "enabling capabilities" for deploying hypersonic weapons. Their cost assessment does not seem to include such expenditure either. With that said, regardless of how inclusive the respective cost assessment may be in the two countries, the gap in current Chinese and U.S. assessment about the relative cost of hypersonic weapons – which affects how many weapons can be procured and deployed – may undermine Chinese confidence in the often heard U.S. statement that as a "niche" capability American CPGS won't be able to threaten China's small nuclear arsenal.

Chinese Understanding of General Impact of Hypersonic Weapons

Creating New Strategic Weapons and Breaking the Nuclear/Conventional Boundary

Given the perceived advantages of hypersonic technology, many Chinese experts believe the implications for using such technology for military purposes would be far-reaching. For instance, a PLA Daily article envisions that breakthroughs in hypersonic technology will help create "new strategic weapons". Although the authors do not clearly define what "strategic weapons" mean, they apparently are referring to long-range strike weapons that are used to threaten key political and military targets. As they point out, if hypersonic technology is applied to existing missiles

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[39] Gao, "Hypersonic Weapons Open New Warfare Situations (高超音速武器开启战争新态势)."; Yazheng (杨亚政) Yang, Songnian (李松年) Li, and Jialing (杨嘉陵) Yang, "Hypersonic Vehicle and Its Key Technologies (高超音速飞行器及其关键技术简论)," *Advances in Mechanics (*力学进展*)* 37, no. 4 (2007).

[40] Jingquan (王景泉) Wang, "Overview of U.S. Military Spacecraft Development (美国军用空间飞机发展概述）," *Space International (*国际太空*)*, no. 5 (2010).

[41] Gao, "Hypersonic Weapons Open New Warfare Situations (高超音速武器开启战争新态势)."

[42] M Elaine Bunn and Vincent A Manzo, "Conventional Prompt Global Strike: Strategic Asset or Unusable Liability?," (DTIC Document, 2011); James M. Acton, "The Need for Speed? Debating Conventional Prompt Global Strike," (Washington, D.C.: Carnegie Endowment for International Peace, September 3, 2013).

[43] Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike*.

and airplanes, the operational effectiveness of such weapons "will achieve a qualitative leap."[44] As a result, "a large number of new strategic weapons will emerge"; these weapons will not be matched by any existing weapon systems, because they "will keep the advantages of ballistic missiles in terms of range and responsiveness, but will also possess the strength of cruise missiles when it comes to high accuracy and low cost."[45] In this regard, Chinese analysts have taken particular note of reported Russian efforts to arm new liquid-fueled heavy ICBMs with conventional warheads, which would thus render them a new type of "strategic conventional intercontinental ballistic missiles."[46]

With these new strategic weapons, China worries that the United States might be tempted to use conventional hypersonic weapons to preemptively strike China's nuclear forces.[47] Even if the nuclear weapons and the delivery vehicles themselves can be protected from such a conventional strike, the command and control system might be vulnerable to conventional strike. [48] American scholars such as Fiona S. Cunningham and M. Taylor Fravel believe China is deliberately making its No-First-Use (NFU) policy a little ambiguous, especially when it comes to the issue of whether China will launch a nuclear retaliation after a conventional counterforce strike against its nuclear forces, in order to deter such conventional strike. They argue that this ambiguity in NFU commitment could instead increase the chances of the nuclear/conventional firewall being broken inadvertently. [49] Senior Chinese military experts such as Major General Yao Yunzhu also points out that increasing conventional threat to Chinese nuclear deterrent is driving debate in the Chinese media (including social media) about the wisdom of unconditional No First Use.[50]

In addition to the concern that the United States may use conventionally armed hypersonic weapons to strike China's nuclear weapons, some Chinese experts also worry that the line between nuclear and conventional wars may be crossed in other ways. For instance, Hu Wenlong from the Academy of Military Sciences, writes that at the current level of technology development, the best way to defend against conventional hypersonic strike "has to be using nuclear-armed air and missile defense systems", especially "the enormous shock wave generated

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[44] Xiaodong (柴晓东) Chai, Huasheng (王华胜) Wang, and Xinhong (周新红) Zhou, "Hypersonic Warfighting Platform Challenges Existing Joint Warfighting Operation System (高超音速作战平台挑战现有联合作战体系)," *PLA Daily (*解放军报*)*, 08/04/2011 2011.

[45] Huaiyu (汤怀宇) Tang and Jie (刘婕) Liu, "Media Reports and China's Hypersonic Weapon (从媒体报道看我国高超音速武器)," *Ordnance Knowledge (*兵器知识*)*, no. 5 (2014).

[46] Shi (何适) He, "Russion Hypersonic Missiles Classified as "Top Secrets" (俄高超音速导弹列入"绝密级")," 2013-01-23.

[47] Xiangli (孙向丽) Sun, "New Challenges and New Agenda for China's Arms Control (中国军控的新挑战与新议程)," *Foreign Affairs Review (*外交评论*)*, no. 3 (2010).

[48] Fiona S Cunningham and M Taylor Fravel, "Assuring Assured Retaliation: China's Nuclear Posture and Us-China Strategic Stability," *International Security* 40, no. 2 (2015).

[49] Ibid.

[50] Yunzhu Yao, "China Will Not Change Its Nuclear Policy," (China-US Focus, Apr 22, 2013).

by the air explosion of nuclear warhead to destroy the high-speed hypersonic vehicle."[51] He believes that this is the "only effective way to conduct interception." As a result, this will "for sure greatly increase the chances of nuclear weapons being used, will lower the nuclear threshold, and will further increase the interconnectivity between conventional and nuclear wars."[52]

Causing New Arms Race

Chinese experts are concerned that the development of hypersonic weapons will have direct impact on existing nuclear arms control arrangements. For instance, they worry that the U.S. development of Conventional Global Strike weapons may motivate Russia to develop its own conventional long-range strike capabilities and therefore to break away from the Intermediate-Range Nuclear Forces Treaty (INF) that imposes constraints on U.S. and Russian conventional missile development.[53] After the abrogation of the Anti-Ballistic Missile Treaty and the stalling of U.S.-Russian bilateral nuclear disarmament process, the breakup of the INF treaty will deal a major blow to the already weakened nuclear arms control regime.[54]

Another concern is that the nature of hypersonic weapons will make arms race inevitable. While nuclear weapons are instruments for deterrence rather than warfighting, hypersonic weapons – according to Chinese analysts – will mainly carry conventional warheads and will therefore more likely to become warfighting weapons on battlefield than weapons for deterrence.[55] Because hypersonic weapons are particularly useful for warfighting, and "can effectively strike high-value targets, achieve 'decisive killing in one shot', and are essential for determining the outcome of war",[56] Chinese experts express a strong concern over the potential for a hypersonic weapons arms race, which from their view could be inevitable.

Thus far, no country has a clear advantage in their hypersonic weapons program. The United States remains the leader in technology development, but it has encountered major setbacks. It has been far from smooth sailing for Russia and China too.[57] But precisely because there is still much uncertainty in the outcome of this competition, all major players will continue to do their best to gain an upper hand in the future. Everyone recognizes that "hypersonic weapons provide

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[51] Hu, "Air-Space Integrated Hypersonic Attack - the Upcoming New Round of Warfare Revolution (空天化高超音速攻击——即将来临的新一轮战争变革)."

[52] Ibid.

[53] "U.S. Navy Explores Submarine Launched Hypersonic Missile (美国海军探索潜射型高超音速导弹)," *Ship Science and Technology (*舰船科学技术*)*, no. 02 (2014).

[54] Zhongping (宋忠平) Song, "Europe Will Get Caught in Arms Race If the U.S. Breaks from Inf Treaty (一旦美废除中导条约 欧洲或陷入军备竞赛)," (China Social Science Network, 2015).

[55] "Us Hypersonic Weapons Testing Will Lead to a New Military Imbalance (美高超音速武器试验将引发新军力失衡)," 2014-09-06.

[56] Hu, "Air-Space Integrated Hypersonic Attack - the Upcoming New Round of Warfare Revolution (空天化高超音速攻击——即将来临的新一轮战争变革)."

[57] Tong (柯同) Ke, "Is Hypersonic Weapon Leading to New Arms Race? (高超音速武器引发新军备竞赛？)," 2015-01-13.

an important capability that is sufficient to change international strategic structure"; as a result, the existing uncertainty about the outcome of future competition over hypersonic technology leaves everyone hoping that it can potentially tip the balance of power to its own favor by investing more into the technology development and therefore makes the incentive for participating in this competition even stronger.[58]

Chinese experts also predict that this competition will inevitably spread into other domains such as outer space. The fact that some hypersonic weapons will be deployed in outer space or travel through space or near-space has convinced some Chinese experts that the hypersonic competition will make space arms race even more likely. According to these experts, because "the operational domains" of hypersonic weapons "are extended to the entire globe and the outer space," hypersonic weapons are bound to "make future wars look very different" and "'Star Wars' will no longer be illusory."[59]

Chinese Perception of China's Motivation in Developing Hypersonic Weapon

A New Revolution in Military Affairs

China's nuclear weapon technology development policies have historically been very much influenced by a desire to follow the steps of other major military superpowers. China's decision to develop nuclear ballistic missile submarines, multiple independently targetable reentry vehicles, neutron bombs, and most recently an early warning system, are all examples of this policy of "not falling behind" on major military technology development. The main purpose of this policy is to avoid a so-called technological surprise.[60] When it comes to the development of hypersonic technology, China's thinking seems to have been somewhat influenced by the same logic. When talking about hypersonic technology, one Chinese analyst made a statement that explains the general Chinese concern: "when there is a technology gap between two countries, the weaker party will not have its say and will for sure fall into crises." Therefore, "if a country's technologies lag behind others, it will be beaten up!"[61] Another Chinese analyst puts it similarly, "the United States cannot monopolize the development of hypersonic vehicles; Europeans are

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[58] Wenjie (单文杰) Shan and Cai Wenyi (蔡闻一), "Russia's "Prompt Global Strike" to Target Whom? (俄"全球快速打击"剑指何方?)," 2014-09-27; Wang, "Hypersonic Leading the New Trend in Aerospace Flight (高超音速引领空天飞行新趋势)."; Ke, "Is Hypersonic Weapon Leading to New Arms Race? (高超音速武器引发新军备竞赛？)."

[59] Chai, Wang, and Zhou, "Hypersonic Warfighting Platform Challenges Existing Joint Warfighting Operation System (高超音速作战平台挑战现有联合作战体系)."

[60] Bin Li, Riqiang WU, and Weidi Xu, "Why Is China Modernizing Its Nuclear Arsenal?" (paper presented at the Carnegie International Nuclear Policy Conference 2015, Washington DC, 2015); Jonathan Ray, "Red China's "Capitalist Bomb": Inside the Chinese Neutron Bomb Program," in *China Strategic Perspectives 8* (Center for the Study of Chinese Military Affairs, Institute for National Strategic Studies, National Defense University, January 2015).

[61] Hu, "Air-Space Integrated Hypersonic Attack - the Upcoming New Round of Warfare Revolution (空天化高超音速攻击——即将来临的新一轮战争变革)."

also developing; so are the Russians and Japanese. Therefore China has no reason not to do so too."[62]

Furthermore, in some of the above-mentioned cases such as the neutron bomb, China only sought to research and master the technology as a "technology reserve" without a clear intention to actually deploy it.[63] In the case of hypersonic technology, however, Chinese experts have been convinced by enthusiasm about hypersonic technology in other major powers that the hypersonic technology represents something much more fundamentally important.

For instance, Chinese defense industry experts do not see the U.S. pursuit of CPGS as a recent effort to combat new threats such as high-value terrorists. Instead, they point out that the United States has long been working on hypersonic technology and now the technology's time has finally come. Experts from the Nanjing University of Aeronautics and Astronautics and the Aviation Industry Corporation of China argue that the United States has paid special attention to hypersonic aircrafts since as early as the 1950s when the United States built the X-15, a hypersonic rocket-powered aircraft that achieved a speed as high as Mach 6.72. The National Aeronautics and Space Administration (NASA) kept working on the X-33, X-34, and other prototypes in the 1990s. Together, these programs formed the foundation for the Hyper-X program, which took the development of hypersonic technologies to a new level such that Chinese experts believe it "shows the pivotal strategic significance" of hypersonic technology to U.S. strategists which precedes and goes beyond just meeting terrorist threat.[64]

That hypersonic technology is of great importance is now a consensus view among Chinese experts. Li Qingyuan and Shi Junhong from China Academy of Launch Vehicle Technology state that "hypersonic technology is becoming the focus of aerospace and aeronautics research (in the world)."[65] Experts from the Third Academy of China Aerospace Science and Industry Corporation conclude that hypersonic vehicle is going to change the patterns and concepts of future warfare.[66] Many Chinese experts, including technical and policy experts, have repeatedly referred to hypersonic technology as the "Third Technology Revolution" in aviation and

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[62] Mu, "China and Us Compet in Developing Hypersonic Missile; Global Anti-Missile Systems May Be Useless (中美争研高超音速导弹 全球反导系统恐将作废)."

[63] Ray, "Red China's "Capitalist Bomb": Inside the Chinese Neutron Bomb Program."

[64] Xiongxin (陈雄昕) Chen et al., "Advances in Aerodynamic Heat Research for Hypersonic Vehicle (高超音速飞行器气动热研究进展)," *Air weapons (*航空兵器*)*, no. 6 (2014).

[65] Qingyuan (李清源) Li and Junhong (史俊红) Shi, "Hypersonic Technology Development Review (高超音速技术发展概述)," *Structure & Environment Engineering (*强度与环境*)* 39, no. 5 (2012).

[66] Long(陈龙) Chen and Erqiang (王二强) Wang, ""Hypersonic": Weapon That Changes the Model of Future Warfare ("高超"：改变未来战争模式的利器)," 2012-08-21.

aerospace history, stating that its high speed and long range "is bound to have far-reaching impact on future warfare and military revolution."[67]

Believing that the United States seeks to broaden its military's technological gap with China, especially on strategic military technologies such as CPGS, a minority of Chinese experts openly call for an outright "military competition" with the United States in this field. They acknowledge that China should avoid an "arms race", but such experts see a "military competition" is a common practice between major power – guided by a rational and sustainable strategy of resources consumption and is much less harmful than an "arms race". These experts believe that China should not shy away from competing for military technology superiority (with the United States) if China's strategic security interests demand it.[68]

Addressing Imminent Security Challenges

The majority of Chinese experts, however, do not see the need for China to master hypersonic technology as primarily to win a technology competition with the United States in the long run. Instead, most experts argue that the most important reason to prioritize hypersonic technology development is the necessity to counter specific security threats from increasingly sophisticated U.S. military technologies, including CPGS.

This logic undergirds several different arguments that Chinese experts have presented in the literature. One such argument is that China needs to research and develop hypersonic technology simply to understand the technology and then find ways to counter U.S. hypersonic weapons. Tang Huaiyu and Liu Jie from the People's Liberation Army Academy of Equipment Command & Technology cite the U.S. Air force's plan to build hypersonic strike weapons that can operate freely against the presence of enemy Anti-Access, Area Denial (A2AD) capabilities by 2030 and argue that China's A2AD capability is "facing the threat from hypersonic weapons, we have to master the same technology in order to develop necessary countermeasures."[69] According to these experts, developing the same technology is the most direct way to regain the pre-existing military balance: "the most critical issue is to break the U.S. absolute superiority (on hypersonic weapons) and to protect one's own security through striving for a strategic balance."[70]

Other Chinese experts tie the need to develop hypersonic technology to specific U.S. weapons programs. One very important argument is that hypersonic technology is a potential solution to address the threat of U.S. ballistic missile defense on China's nuclear deterrent. As mentioned

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[67] Chai, Wang, and Zhou, "Hypersonic Warfighting Platform Challenges Existing Joint Warfighting Operation System (高超音速作战平台挑战现有联合作战体系)."; Wang, "Hypersonic Missiles for the Future (为未来而来的高超音速导弹)."; Wang, "Hypersonic Leading the New Trend in Aerospace Flight (高超音速引领空天飞行新趋势)."; Li et al., "Near Space Hypersonic Weapon Defense Review (临近空间高超音速武器防御综述)."

[68] Hu, "Air-Space Integrated Hypersonic Attack - the Upcoming New Round of Warfare Revolution (空天化高超音速攻击——即将来临的新一轮战争变革)."

[69] Tang and Liu, "Media Reports and China's Hypersonic Weapon (从媒体报道看我国高超音速武器)."

[70] Ke, "Is Hypersonic Weapon Leading to New Arms Race? (高超音速武器引发新军备竞赛？)."

above, the majority of Chinese experts believe that "hypersonic vehicles have very high penetration probability against ballistic missile defense systems."[71] They argue that "if a country can develop a weapon that can effectively break the U.S. ballistic missile defense systems, the difficult security problem will be non-existent. This is the greatest value of hypersonic vehicle."[72] Some even claim that because hypersonic weapon can penetrate ballistic missile defense systems, "the shock it will bring to the world is going to be no less than that of nuclear weapons." This is why Chinese experts believe hypersonic vehicles "are extremely important".[73]

Specifically, some see hypersonic cruise missiles as the best means to improve China's nuclear deterrent against U.S. missile defense capabilities. They argue that unlike ballistic missiles, hypersonic cruise missiles do not need complex mission planning and can launch quickly after operators receive target information and a launch order.[74] Furthermore, according to some Chinese experts, hypersonic cruise missiles fly at an altitude of approximately 25 kilometers, which is beyond the reach of most enemy air defense capabilities. The missiles' high maneuverability allows them to defeat most ballistic missile defense systems such as PAC-3 or SM-3.[75] And because current Chinese nuclear warhead delivery relies primarily upon vulnerable ballistic missile systems which are "facing serious threat" from anti-missile technology, some Chinese experts assert that mounting nuclear warheads on hypersonic missiles would "greatly enhance our capability to deal with the enemy's missile defense threat."[76]

Chinese experts are keen to note that China is not the only country interested in the potential of hypersonic weapons to counter rivals' anti-missile systems. They believe Russia's efforts in developing hypersonic weapons are also aimed at "breaking the America's 'global anti-missile system'" and that Russia is "striving to achieve breakthrough of key (hypersonic) technology in order to complete the weaponization of such (hypersonic) technology."[77] Retired Major General Xu Guangyu also points out that hypersonic weapons "make interception more difficult," which is why the United States, Russia, and India are all investing in the development of hypersonic

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[71] Peng (崔鹏) Cui, "China's Hypersonic Aerocraft Test Reeives International Attention (我高超音速飞行器试验引关注)," 2014-01-21.

[72] Xuesong (张雪松) Zhang, "Why Are Hypersonic Flight Technologies Difficult? (高超音速飞行技术难在哪里?)," 2014-01-25.

[73] Ibid.

[74] Tang and Liu, "Media Reports and China's Hypersonic Weapon (从媒体报道看我国高超音速武器)."

[75] Cui, "China's Hypersonic Aerocraft Test Reeives International Attention (我高超音速飞行器试验引关注)."; Tang and Liu, "Media Reports and China's Hypersonic Weapon (从媒体报道看我国高超音速武器)."

[76] "Media Reports and China's Hypersonic Weapon (从媒体报道看我国高超音速武器)."

[77] Song, "Us Hypersonic Weapons Testing Will Lead to a New Military Imbalance (美高超音速武器试验将引发新军力失衡)."

weapons.[78] For this reason, Chinese experts believe that their development of hypersonic technology is necessary for correcting the trend of growing imbalance between the U.S. and China and therefore should contribute to a more stable bilateral nuclear relationship and international order.[79]

Chinese Perception of U.S. Motivation and Capability of Its Hypersonic Weapon Program

Some Chinese experts take note of the fact that U.S. investment into CPGS in recent decades was originally driven by a perceived need to strike high-value terrorist targets in a timely manner.[80] But different from one well-known Western analysis,[81] most of Chinese experts tend not to see the U.S. hypersonic development program as primarily technology-driven. Rather, many Chinese experts make it very clear that they believe the United States has been motivated to obtain the capability to launch preemptive conventional strike to destroy an enemy's strategic military assets.[82] Some believe that an enemy's nuclear forces are included in the intended targets of American conventional hypersonic strike. One Chinese analyst articulates this view particularly clearly: "The U.S. objective is once it is in a conflict with an enemy country, it can use hypersonic weapons to wipe out the other's nuclear forces or chemical and biological weapons. Then the United States can send out airplanes to conduct preemptive air strike. This strategy will ensure the United States' absolute strategic advantage."[83]

The literature suggests that this is a shared concern among Chinese experts. Said experts do diverge in their analyses of how far the United States will go for using its CPGS capabilities in counternuclear missions. For instance, some seem to believe that the U.S. CPGS systems will only play a supplementary role to its existing nuclear strike capabilities, while others believe that the United States is planning to create a new category of "conventional strategic weapons" that can gradually replace nuclear weapons because they can be used more easily and flexibly without causing tremendous civilian collateral damage. Li Qingyuan and Shi Junhong from China Academy of Launch Vehicle Technology assert that "the reason why the United States had no difficulty in assigning the New START (Strategic Arms Reduction Treaty) on April 8 2010, is that the United States has established new types of conventional strategic strike capabilities in military

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[78] Zhang, "Why Are Hypersonic Flight Technologies Difficult? (高超音速飞行技术难在哪里?)."

[79] Hu, "Air-Space Integrated Hypersonic Attack - the Upcoming New Round of Warfare Revolution (空天化高超音速攻击——即将来临的新一轮战争变革)."

[80] Hui (安慧) An, "Closely Watched Test of Advanced Hypersonic Weapon (倍受关注的先进高超声速武器试验)," *Space Exploration (*太空探索*)*, no. 10 (2014); Liping (夏立平) Xia, "Us Conventional Prompt Global Strike Plan from the "High Frontier" Theory Perspective ("高边疆"理论视阈下美国全球快速常规打击计划)," *International Observer (*国际观察*)* 5 (2014); Ke, "Is Hypersonic Weapon Leading to New Arms Race? (高超音速武器引发新军备竞赛？)."

[81] Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike*.

[82] Hong (黎弘) Li, "Complex and Diverse Global Nuclear Security Environment (复杂多元化的全球核安全环境)," *Peace and Development (*和平与发展*)* 3 (2010); Fang, "U.S. Pushes Forward with Prompt Global Strike Program (美国推进快速全球打击计划)."

[83] Ke, "Is Hypersonic Weapon Leading to New Arms Race? (高超音速武器引发新军备竞赛？)."

domains where other countries have achieved no advantage such as in the outer space." "The United States," as they claim, "is in a transition from nuclear strategic strike capability to conventional strategic strike capability."[84]

There are also Chinese experts who see the U.S. CPGS systems as primarily aimed at striking non-nuclear strategic targets. The main U.S. objective, they believe, is to address "the limits of existing non-nuclear strike capabilities" and to "effectively meet the needs of promptly striking time-sensitive high-value targets."[85] As a result, the United States can spare nuclear weapons from responding to some non-nuclear contingency scenarios.[86]

At the sub-strategic level, Chinese experts recognize that U.S. CPGS systems will be used to counter China's so-called Anti-Access/Area Denial (A2AD) capability. They point to Department of Defense publications and U.S. think tank reports that have explicitly pointed out that in potential conflicts and wars between the United States and regional powers, Conventional Prompt Global Strike weapons are important instruments for countering A2AD because of their high speed and high penetration capabilities.[87] Besides, Chinese experts perceive the planned U.S. CPGS systems as a particular threat to China's A2AD capability because CPGS weapons' long-range standoff capability makes them less dependent on forward deployment on overseas military bases for conducting strikes and thus renders them less vulnerable.[88]

Even though U.S. officials and experts have tried at Track II level bilateral dialogues to dismiss the Chinese claim that the United States seeks to obtain so-called "absolute security,"[89] the U.S. development of CPGS program has only reinforced the Chinese conviction that the United States is still seeking "absolute security," often at the expense of other countries' security. Chinese analysts argue that hypersonic weapons make the United States capable of conducting accurate long-range standoff strikes, which minimizes the risk of U.S. troops and pilots while also reducing the political and diplomatic cost of flying military aircraft over non-involve countries en route to their intended target. In the final analysis, Chinese analysts maintain that the U.S. military, despite its sizeable technological advantage over potential adversaries, still strives to "further broaden the gap with other countries by seeking to establish strong technological

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[84] Li and Shi, "Hypersonic Technology Development Review (高超音速技术发展概述)."

[85] Youpei (方有培) Fang et al., "Us "Global Strike" System Technology Defect Analysis (美军"全球快速打击"系统技术缺陷分析)," *Aerospace Electronic Warfare (*航天电子对抗*)* 29, no. 3 (2013).

[86] Zhang and Huang, "Status of Research and Impact of Long-Range Prompt Strike Weapons (远程快速打击武器的研究现状和影响)."

[87] Fang et al., "Us "Global Strike" System Technology Defect Analysis (美军"全球快速打击"系统技术缺陷分析)."

[88] Aiguo (党爱国) Dang, Xiaojun (李晓军) Li, and Bao (徐宝) Xu, "Foreign Military Rapid Global Strike Capability Developments (外军快速全球打击能力发展动态)," *Cruise Missile (*飞航导弹*)* 7 (2012); Hu, "Air-Space Integrated Hypersonic Attack - the Upcoming New Round of Warfare Revolution (空天化高超音速攻击——即将来临的新一轮战争变革)."

[89] Brad Glosserman, David Santoro, and Ralph A Cossa, "Us-China Strategic Nuclear Relations: Time to Move to Track-1 Dialogue," *Issues and Insights* 15, no. 7 (2015).

superiority in hypersonic vehicles," and "such technology will have serious negative implications for international security."[90] All this, as argued by Chinese analysts, points to "the U.S. pursuit of absolute superiority and absolute security."[91] As a result, they worry that "other countries which are put into insecurity as a result," will "for sure take measures to protect its own security. These countermeasures will certainly introduce new uncertainties into the international security situation."[92] The end result, as they imply, might be serious security dilemma that does not serve anyone's interests.

In summary, Table 2 compares U.S. openly expressed motivations for developing hypersonic weapons and Chinese perception of whether these are real U.S. motivations. Because the U.S. government has yet to provide any authoritative statement about what military objectives it seeks to achieve through CPGS weapons, this table builds up James Acton's comprehensive summary of what U.S. government officials have mentioned at various occasions about possible missions for CPGS weapons.[93] As Table 2 shows, Chinese experts agree that preemptive counternuclear – preemptive strike to disarm an adversary's nuclear forces – and defense suppression (counter A2AD) are very important motivations of U.S. CPGS program. They haven't addressed very much the issue of retaliatory counternuclear – military strike to destroy an adversary's remaining nuclear forces after one is already attacked by nuclear weapons. This seems a result of the general Chinese conviction that nuclear wars can be avoided but not managed; as long as a nuclear war breaks out, it basically means an all-out nuclear exchange, with little room for managing or controlling escalation.[94] As a result, Chinese experts have not been particularly interested in discussing specific escalation scenarios after the nuclear threshold is crossed.

It is also necessary to note that the United States has stated that the counternuclear mission for CPGS weapons is only aimed at countering North Korean and Iranian (if Iran develops nuclear weapons) nuclear forces.[95] The Nuclear Posture Review Report drafted by the Obama administration explicitly states that "any future U.S. conventionally-armed long-range ballistic

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[90] Wang, "Hypersonic Leading the New Trend in Aerospace Flight (高超音速引领空天飞行新趋势)."

[91] Zhongyan (胡仲衍) Hu, Changfu (郭昌福) Guo, and Xiaodong (耿晓东) Geng, "Us Hijacks the World with Hypersonic Missiles (美用高超音速导弹 "挟持全球")," *Global Military (*环球军事*)*, no. 5 (2009).

[92] Kelin (全克林) Quan, "On the Us "Prompt Global Strike" Plan (略论美国的 "快速全球打击" 计划)," *Contemporary International Relations (*现代国际关系*)*, no. 11 (2007).

[93] Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike*.

[94] Jiadong (张家栋) Zhang and Xin (金新) Jin, "Sino-U.S. New Type of Major Power Relationship: History, Theory, and Reality (中美新型大国关系: 历史, 理论与现实)," *International Observer (*国际观察*)* 5 (2013).

[95] "The Status of United States Strategic Forces," (U.S. House of Representatives Armed Services Committee, Strategic Forces Subcommittee, March 2, 2011); "Report of the Defense Science Board Task Force on Time Critical Conventional Strike from Strategic Standoff," (Washington, D.C.: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, 2009); Thomas Scheber and Kurt Guthe, "Conventional Prompt Global Strike: A Fresh Perspective," *Comparative Strategy* 32, no. 1 (2013).

missile systems are designed to address newly emerging regional threats, and are not intended to affect the strategic balance" with other nuclear weapons states.[96] However, such U.S. statements do not seem to have alleviated Chinese concerns. Chinese analysts take the assumption that U.S. conventional threat to Chinese nuclear deterrent is real and China needs to address the threat seriously.

Counterterrorism used to be a primary focus of U.S. CPGS development. The 2009 report of the Defense Science Board Task Force listed five scenarios for using CPGS weapons, and three of them are about striking various terrorist targets.[97] Although some Chinese experts acknowledge counterterrorism was the original motivation for the United States to pursue hypersonic technology,[98] many don't think this is an important motivation, compared to other strategic military benefits that the United States will obtain from mastering such technology.[99] Another interesting contrast is that counter-ASAT (anti-satellite) has been repeatedly discussed by U.S. experts and officials as a possible mission for CPGS weapons.[100] And given the high-level attention in the United States about China's ASAT capability, China is apparently the main target of such counter-ASAT operations by CPGS weapons. But there has been little open discussion in China about this U.S. motivation, in either a preemptive or retaliatory U.S. counter-ASAT scenario against China.

Table 2. Chinese Perception of U.S. Stated Motivations

U.S. Perception of U.S. Motivations	**Chinese View of U.S. Stated Motivations**
Counterterrorism	Not important motivation
Preemptive counternuclear	Important motivation
Retaliatory counternuclear	Little/no discussion
Preemptive counter-ASAT	Little/no discussion
Retaliatory counter-ASAT	Little/no discussion
Defense suppression	Important motivation

[96] "Nuclear Posture Review Report."

[97] Ronald Kerber and Robert Stein, "Report of the Defense Science Board Task Force on Time Critical Conventional Strike from Strategic Standoff," (Washington DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, 2009).

[98] Xia, "Us Conventional Prompt Global Strike Plan from the "High Frontier" Theory Perspective ("高边疆" 理论视阈下美国全球快速常规打击计划)."

[99] Ke, "Is Hypersonic Weapon Leading to New Arms Race? (高超音速武器引发新军备竞赛？)."

[100] Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike*; Amy F Woolf, "Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues," in *CRS Report for Congress* (Washington DC: Congressional Research Service, May 5, 2014).

When it comes to the specific impact of the U.S. CPGS development on China, very few Chinese experts have written about how specifically the introduction of hypersonic weapons might affect escalation dynamics between the two nuclear states. There are also very few publications about how such strategic conventional weapons might be incorporated into an overall deterrent posture. For instance, there have been no publications on the subject of "cross-domain deterrence," and there have been only one journal article (published in *National Defense*) and five newspaper articles on the subject of "cross-domain operation."[101] All of these were published after 2012, and most of them are analyses of U.S. discussions on cross-domain strategy and are aimed primarily at updating Chinese decision-makers on new U.S. thinking.

Most Chinese experts focus on implications at the strategic level. First and foremost, they worry about the negative impact on survivability of China's limited nuclear arsenal and the consequent impact on crisis stability. It is a commonly expressed concern that the introduction of hypersonic weapons by the United States "increases the chances that the United States will use conventional prompt global strike weapons against Chinese nuclear weapons."[102] Xia Liping, a professor at Tongji University, explains the often heard Chinese view of how CPGS threatens China's nuclear deterrent, when used jointly with American missile defense capability: "The United States has the world's largest nuclear weapons, which means it has the best spear; and it has been building missile defense systems, which means it will have the best shield. Now if the United States deploys conventional prompt global strike weapons, it means it will have in its possession double spears (nuclear weapons and CPGS)"; "Together with the protection from the shield (missile defense)", these will "greatly enrich the options and enhance the willingness of the United States to launch preemptive strike against others." He believes that this will break the existing international strategic balance and "seriously challenge international strategic stability."[103]

At the non-nuclear level, Chinese experts believe CPGS will encourage the United States to engage in more activities that violate or interfere with others' national sovereignty. Citing a Department of Defense Science Defense Board report, Chinese experts conclude that "in three of the five scenarios when the United States might use conventional prompt global strike, the strike takes place in a neutral country… This is a violation of this country's sovereignty."[104] Furthermore, Chinese experts see Beijing's development of so-called A2AD capability as aimed at defending against U.S. interference. Therefore, the expressed U.S. intention in using CPGS against A2AD systems has been interpreted by Chinese experts as indicative of a greater U.S. willingness to conduct more aggressive military interference, which "will raise the intensity of

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[101] Gaoyue (樊高月) Fan, "Analysis of U.S. "Cross Domain Synergy" Operations (美军 "跨域协同" 作战思想探析)," *National Defense (*国防*)*, no. 2 (2015).

[102] Xia, "Us Conventional Prompt Global Strike Plan from the "High Frontier" Theory Perspective ("高边疆" 理论视阈下美国全球快速常规打击计划)."; Ke, "Is Hypersonic Weapon Leading to New Arms Race? (高超音速武器引发新军备竞赛？)."

[103] Xia, "Us Conventional Prompt Global Strike Plan from the "High Frontier" Theory Perspective ("高边疆" 理论视阈下美国全球快速常规打击计划)."

[104] Ibid.

regional conflicts, and become an important driving force for regional conflicts and escalation."[105]

Many experts have expressed concern that the development of hypersonic weapons will lead to an arms race. They point out that the United States and Russia are already engaging in such an arms race,[106] and they do not exclude the possibility that China will have to be involved too.[107] According to some, this new arms race is an arms race at the strategic level and will be especially consequential. Because of the implications of hypersonic weapons on nuclear deterrent and balance of strategic military capability, as they argue, this arms race around hypersonic weapons would be the third major arms race after the introduction of nuclear weapons and stealth technology.[108]

Possible Chinese Responses to U.S. Capability

Most of the proposed countermeasures by Chinese experts are focused on how to maintain China's nuclear retaliation capability. Such proposals can be grouped into the following categories. First, the most straightforward solution is for the United States and China to agree not to use conventional weapons to strike each other's nuclear forces and nuclear facilities (or at least no first use of conventional weapons against each other's nuclear capabilities).[109] The optimistic side of this proposal is that it is not totally unprecedented in history to accomplish similar diplomatic arrangement. India and Pakistan, for instance, have implemented a mutual agreement since 1991, prohibiting them from attacking each other's facilities that contain radioactive materials. The pessimistic side is that for a long time the United States has resisted reaching any agreement with China foreswearing first use of even nuclear weapons. It will require tremendous diplomatic efforts to convince Washington to accept a no (first) use of conventional weapons agreement. Given that the United States is building hypersonic weapons precisely to give the president more options during crisis, it seems unlikely that Washington would give the option up easily. Of course, even if an agreement to regulate the use of conventional weapons can be reached, how stable such agreement can be is another major issue that has not been thoroughly discussed.

Second, if the threat from U.S. conventional first strike cannot be adequately addressed through diplomatic arrangements, Chinese experts have proposed unilateral steps to bolster its nuclear deterrence capabilities. For instance, a number of Chinese experts argue that China needs to enhance its so-called "asymmetric nuclear strike" posture. The thinking is that, since the U.S.

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[105] Ibid.; An, "Closely Watched Test of Advanced Hypersonic Weapon (倍受关注的先进高超声速武器试验)."; Fang, "U.S. Pushes Forward with Prompt Global Strike Program (美国推进快速全球打击计划)."

[106] Wen (牛文) Niu et al., "Development Review of 2014 Foreign Hypersonic Technology (2014 年国外高超声速技术发展动态回顾)," *Cruise Missile (*飞航导弹*)* 1, no. 1 (2015).

[107] Ke, "Is Hypersonic Weapon Leading to New Arms Race? (高超音速武器引发新军备竞赛？)."

[108] Xia, "Us Conventional Prompt Global Strike Plan from the "High Frontier" Theory Perspective ("高边疆" 理论视阈下美国全球快速常规打击计划)."

[109] Ibid.

hypersonic development program is much ahead of that of China, it is likely that when the United States starts to deploy hypersonic weapons in the future, Chinese hypersonic weapons will still be in development. In that case, Chinese experts argue, China will be under serious threat from U.S. hypersonic strike; and if such strike takes place, China will need to "use asymmetric retaliation to dissolve the enemy's determination to conduct further hypersonic strikes."[110] This seems to imply that these experts believe China may need to launch nuclear retaliation against a conventional hypersonic strike. Similarly, in response to the perceived CPGS threat, some experts suggest China readjust its long-standing NFU policy from an unconditional NFU of nuclear weapons to a conditional NFU policy, i.e., China should be able to launch a nuclear retaliation after its nuclear weapons are struck by non-nuclear weapons.[111]

Some experts call for China to increase the number of submarine-launched ballistic missiles and land-mobile ICBMs to ensure the survivability of China's nuclear deterrent.[112] Some even go as far as to argue that China should develop some type of nuclear warfighting capability. This is a very rarely heard view, but some serious military professionals have expressed such opinions. For example, Yuwen Jingbo and Tang Liwen from the People's Liberation Army Academy of Equipment Command & Technology cite an article published on the Journal of Second Artillery Command College and assert that "since the first day when China became a nuclear weapons state, China has promised not to use nuclear weapons first. However, the emergence of PGS has posed new challenges to our nuclear strategy: the United States can use conventional weapons to strike our nuclear facilities. Therefore, we should, without changing the basic principles of nuclear strategy, change the utility of nuclear weapons from strategic deterrent to a combination of deterrent and warfighting."[113] A nuclear response to conventional strike on nuclear forces could have negative implications for strategic stability because such policy would make it difficult for one to draw a clear redline for nuclear retaliation. A conventional strike on one's nuclear forces may cause limited but nonfatal damage; this would present one with a dilemma of whether a nuclear response is justified or necessary. Without a clear and unequivocal redline, one's nuclear deterrent could be undermined rather than strengthened, and crisis stability could be adversely affected as well.

Third, some experts argue that China can maintain the mutual deterrent relationship with the United States by obtaining its own hypersonic weapons.[114] It is no secret that China is already

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[110] Jing (张晶) Zhang, Zhenghong (贺正洪) He, and Bo (王博) Wang, "Near Space Hypersonic Vehicle Development and Defense Strategies (临近空间高超声速飞行器发展及防御策略研究)," *Cruise Missile (*飞航导弹*)* 4 (2015).

[111] Xia, "Us Conventional Prompt Global Strike Plan from the "High Frontier" Theory Perspective (“高边疆” 理论视阈下美国全球快速常规打击计划)."

[112] Ibid.

[113] Jingbo (宇文静波) Yuwen and Liwen (唐立文) Tang, "Discussion and Implications of the American "Prompt Global Strike" Program (美国 “快速全球打击” 计划探讨与启示)," *Journal of the People's Liberation Army Academy of Equipment Command & Technology (*装备指挥技术学院学报*)* 22, no. 3 (2011).

[114] Xia, "Us Conventional Prompt Global Strike Plan from the "High Frontier" Theory Perspective (“高边疆” 理论视阈下美国全球快速常规打击计划)."

conducting research on hypersonic technology and has reportedly done a few test flights over the past couple of years.[115] The question is, however, how would China achieve a "mutual deterrent" with the United States by developing its own hypersonic capability? Given the fact that the Chinese nuclear arsenal is much smaller and much more vulnerable than that of the United States, it is much easier, at least in theory, for the United States to conduct a conventional first strike against Chinese nuclear weapons than vice versa. But the Chinese experts have not elaborated on what this "mutual deterrent" might mean at the operational level. It is possible that China believes its capability to threaten a small number of U.S. targets through the use of hypersonic weapons would be sufficient to deter the United States from using similar weapons against China. After all, China has maintained a small nuclear arsenal because of its belief that a very limited nuclear retaliation would be sufficient to deter even a nuclear superpower from launching nuclear strike against China. If this is true, China might choose to focus on obtaining hypersonic technology rather than building up its hypersonic weapon stockpile in the future. This may help minimize the potential impact on existing strategic stability.

Fourth, probably because that it is not easy for China's own hypersonic weapons to effectively neutralize or balance the U.S. hypersonic advantage, some Chinese experts believe that China needs a defensive capability against hypersonic weapons at the end of the day. Some technical experts have conducted research about how this might be done and pointed out a few ways to work towards this goal. Active defense measures primarily entail two options: first, building both an integrated early warning and tracking system and new land-, air-, and space-based interception systems that respond quickly and travel fast enough to intercept hypersonic targets; and second, developing new concept weapons such as railgun.[116] Passive defense measures include further increasing the mobility of land-based missiles, enhancing the physical robustness of key military targets, and building back-up facilities.[117] China has already taken some of these measures, like building robust underground facilities to shelter missiles and other key military targets. While the construction of these facilities will increase the survivability of China's nuclear forces, it may also lead to a lesser degree of military transparency, given that military activities in underground facilities will be more difficult to monitor. The concept of strategic stability builds on the premise that countries have a relatively good understanding about each other's strategic military capabilities. Therefore, declining transparency will have a negative impact on strategic stability.

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[115] Richard D Fisher Jr, "Us Officials Confirm Sixth Chinese Hypersonic Manoeuvring Strike Vehicle Test," *IHS Jane's Defence Weekly* (26 November 2015).

[116] Liu, He, and Wu, "Analysis of Developing Trend of Defending against Hypersonic Targets in Future Air Defense and Anti-Missile Operations (未来防空反导作战中高超声速目标的发展趋势分析)."; Jianbin (李剑斌) Li et al., "Near Space Hypersonic Targets Ascent Phase Interception Requirements Analysis (临近空间高超声速目标上升段拦截需求分析)," *Modern defense technology (*现代防御技术*)* 42, no. 005 (2014); Hailin (张海林) Zhang et al., "Characteristics of near Space Hypersonic Missile Targets (临近空间高超声速导弹目标特性研究)," *Cruise Missile (*飞航导弹*)* 2 (2015); Jing (张晶) Zhang, Zhenghong (贺正洪) He, and Bo (王博) Wang, "Near Space Hypersonic Vehicle Development and Defense Strategies (临近空间高超声速飞行器发展及防御策略研究)," ibid.4.

[117] Liu et al., "Thoughts on Hypersonic Cruise Missile Combat Characteristics and Offense-Defense Model (高超声速巡航导弹作战特点及攻防模式思考)."

Fifth, because of the belief that the U.S. development of CPGS, especially the unmanned spacecraft such as X-37, will inevitably lead to further militarization of outer space, some Chinese experts argue that China has to follow suit and enhance its own efforts in conducting "military aerospace technology research." Such research will include space weapon launch and propulsion technology; surveillance, reconnaissance, and early warning technology; navigation and control technology; and reliable communication technology, among others.[118] Such thinking reveals how a competition in hypersonic technology can carry the extra risk of spilling over and exacerbating arms competitions in other domains like the outer space. An intensified arms competition in outer space will further complicate efforts to maintain existing strategic stability.

One option that is missing from Chinese proposed responses is diplomatic arrangement to limit the size of hypersonic arsenals. Even though U.S. officials have for a number of times referred to U.S. CPGS as a "niche capability" that is going to be very limited in number, no Chinese experts have suggested a negotiated agreement with the United States on capping or limiting hypersonic weapon deployment. This may be due to possible Chinese perception that it is too early to think about hypersonic arms control now given the technology is still under development. But this may also reveal some deeper thinking by Chinese experts. For instance, this might be a result of the Chinese perception that the United States and Russia are the two leading actors in the hypersonic arms competition,[119] and therefore the only likely solution is for these two countries to agree to negotiate first before others can be involved. The second possible explanation is that Chinese experts do not think a negotiated arrangement on total numbers is likely to happen at all. This pessimistic assessment may indicate a rather bleak future for hypersonic arms control.

Conclusion and Lessons to Be Learned

Chinese experts have serious concerns that hypersonic weapons can undermine the credibility of China's nuclear deterrent. They worry particularly that U.S. CPGS weapons will be used against Chinese nuclear forces together with U.S. nuclear strike and missile defense capabilities. Against the combined forces of these U.S. capabilities, China's nuclear retaliation capability might be vulnerable. Consequently, Chinese experts propose a wide range of countermeasures, some of which involve changing China's relative restrained nuclear posture, calling for further expansion of the nuclear arsenal, and even building some kind of nuclear warfighting capability to respond to CPGS strikes.

Even though Chinese experts are concerned about the possibility that hypersonic weapons could blur the line between nuclear and conventional weapons and thus greatly increase the dangers of escalation, they have not elaborated on the specific pathways that hypersonic weapons would cause nuclear escalation. Looking at China's own nuclear development, it is clear that China has been introducing new dual-use missile systems (e.g. DF-21 and DF-26) that can accommodate both nuclear and conventional warheads and that do not seem to exhibit distinctive physical features between the nuclear and conventional models. This contradictive practice may indicate that there is no consensus yet within the Chinese strategic community about the importance of

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[118] Yuwen and Tang, "Discussion and Implications of the American "Prompt Global Strike" Program (美国 "快速全球打击" 计划探讨与启示)."

[119] Niu et al., "Development Review of 2014 Foreign Hypersonic Technology (2014 年国外高超声速技术发展动态回顾)."

segregating the nuclear and the conventional domains, and there may still be serious lack of understanding about the practice of cross-domain deterrence and about managing escalations with intermingled conventional and nuclear capabilities.

There seems a general consensus among Chinese experts that it is imperative for China to develop its own hypersonic weapons. At the strategic level, this seems to be largely driven by the widely-accepted perception that hypersonic weapons would be very effective in penetrating U.S. missile defense systems. At the technical level, this is driven by the overwhelming consensus that hypersonic technology is going to bring about one of the most important military technology revolutions in the world's history and therefore that China cannot fall behind. To many Chinese experts, arms competition or even arms race around hypersonic weapons is inevitable and already happening. Because there is still great uncertainty about the future development of this technology and about who may become the ultimate winner of this competition, Chinese experts think the competition will be extraordinarily intense. Consequently, they are not pinning their hope for minimizing the destabilizing impact of hypersonic weapons on hypersonic arms control.

The emerging competition between China and the United States illustrates that fear and mismatched perception are contributing to biased understandings about each other's intentions and therefore have exacerbated existing security dilemma. From the perspective of some Western scholars who follow closely the development of U.S. CPGS program, the U.S. program has been largely driven by technology rather than by strategic planning. They see this as a major problem that needs to be addressed by giving more strategic thinking about future development and deployment of such technologies.[120] The Chinese experts, on the other hand, see the U.S. pursuit of hypersonic weapons without clearly expressed military purposes as evidence that the United States is simply trying to reinforce its military superiority and therefore seeking "absolute superiority and absolute security."[121] As one expert puts it, "from the perspective of current military power balance, the U.S. military capability and especially its weapons and military equipment are far ahead of other countries. Under these circumstances, why is the United States promoting the new warfare revolution? Fundamentally speaking, this reflects the endless political pursuit by the United States for sustainable hegemonic power in the world."[122] Even Chinese technical experts share the same view that the U.S. tests of hypersonic vehicles are aimed at "urgently promoting the weaponization of hypersonic technologies" in order to "reinforce the U.S. position as the world's hegemon."[123]

At the operational level, there is some debate among Chinese experts about whether the U.S. CPGS program has a clear strategic objective and whether it has been well managed with an internally coherent logic. Some Chinese experts point out that the U.S. CPGS program has

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[120] Acton, "The Need for Speed? Debating Conventional Prompt Global Strike."

[121] Hu, Guo, and Geng, "Us Hijacks the World with Hypersonic Missiles (美用高超音速导弹 "挟持全球")."; "Experts: U.S. X-37b Aerospace Plane More Dangerous Than Nuclear Weapons (专家：美国x-37b空天战机比核武器更危险)," *Global Times* April 8, 2010.

[122] Hu, "Air-Space Integrated Hypersonic Attack - the Upcoming New Round of Warfare Revolution (空天化高超音速攻击——即将来临的新一轮战争变革)."

[123] Li and Shi, "Hypersonic Technology Development Review (高超音速技术发展概述)."

suffered organizational problems and lack of strategic objectives,[124] the similar problems identified by Western experts.[125] But more Chinese experts believe that the U.S. program is very much internally coherent and managed systematically by a top-down process. Experts from the Beijing Aerospace Long March Scientific and Technical Information Institute (part of the China Aerospace Science and Technology Group) and National University of Defense Technology all agree that the U.S. CPGS program is directly mandated by the top U.S. leadership and carried out in a well-coordinated manner among defense industry players. They even call for China to follow the U.S. example to better organize its own hypersonic development.[126] Such (mis)perceptions contribute to Chinese belief that the United States has an overall strategic objective and well thought-out plan to develop CPGS capabilities.

The United States and China are already engaged in a negative action-reaction spiral with regard to the development of hypersonic weapons, which reflects an intense security dilemma between the two. China's motivation in developing its own hypersonic weapons may be multifold, including to penetrate the U.S. missile defense systems and to understand the technology in order to develop countermeasures or to build a "technology reserve." From the Chinese perspective, these are primarily responsive measures to the U.S. missile defense and CPGS programs. But as China responds to U.S. programs, the United States has started to see the Chinese countermeasures as an original security threat in and of themselves. A U.S. House of Representatives committee report on the 2015 Defense Authorization Bill expresses concern that "China and other competitor nations pose an increasing challenge to the United States' technology edge in … hypersonic weapons." The report requires the Pentagon to "explain how the Department of Defense intends to develop and deploy a defensive capability to counter this emerging threat."[127] Such negative action-reaction dynamics is bound to cause more frictions between the two countries down the road and is not likely to increase any party's security in the long term.

At the fundamental level, the reason hypersonic weapon development contributes to security dilemma between Washington and Beijing is that to some extent the development programs in both countries are technology-driven rather than guided by clear military objectives. Both countries need time to study the full potential of this new technology before they can decide how to employ it to achieve what military purpose. Their inability to articulate clear military objectives for their own programs makes it very difficult for them to reassure each other.

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[124] Zilin (魏子淋) Wei, Zhide (刘治德) Liu, and Xiangdong (徐向东) Xu, "Us near Space Prompt Global Strike Weapons Status and Development (美军临近空间快速全球打击武器现状与发展)," *Cruise Missile (*飞航导弹*)* 2 (2012).

[125]See, for example: James M. Acton, "Prompt Global Strike: American and Foreign Developments," (Testimony: House Armed Services Subcommittee on Strategic Forces, December 8, 2015).

[126] Youli (王友利) Wang and Hongtao (韩洪涛) Han, "Impact of Hypersonic Technology on Future Aerospace Equipment Technology Development (高超声速技术发展对未来航天装备的影响)," *Cruise Missile (*飞航导弹*)* 8, no. 8 (2014); Zhang and Huang, "Status of Research and Impact of Long-Range Prompt Strike Weapons (远程快速打击武器的研究现状和影响)."

[127] "Howard P. "Buck" Mckeon National Defense Authorization Act for Fiscal Year 2015: Report of the Committee on Armed Services House of Representatives on H.R. 4435".

When it comes to the nuclear equation, the United States has expressed interest to use hypersonic weapons to strike small nuclear arsenals such as that of North Korea. However, for Chinese analysts, the size of a U.S. hypersonic weapon stockpile that can hold North Korean nuclear arsenal at risk might not be very much distinguishable from one that can threaten Chinese nuclear arsenal. After all, China today only has about dozens of intercontinental ballistic missiles that can reach the continental United States. Furthermore, even if the United States can draw a clear line between the two military missions and can demonstrate effectively that its hypersonic weapon stockpile can only threaten North Korean nuclear arsenal (which continues to grow) without threatening Chinese nuclear arsenal, the line might be easily crossed. This is because some Chinese experts, as mentioned above, believe that hypersonic weapons can be easily mass-manufactured at affordable cost. Therefore, different U.S. and Chinese understandings about some technical features – such as the cost – of future hypersonic weapons further exacerbate the security dilemma.

On the U.S. side, its concern about China's hypersonic weapon development program is vague and abstract, just as the House committee report's statement above indicates. Except China's development and deployment of anti-ship ballistic missile which is believed to be armed with a reentry vehicle that can glide to target and which can threaten large U.S. surface ships,[128] Washington has not identified specific threats from China's program on hypersonic weapon development. It is dangerous to allow such vague and abstract concern drive each other's arms competition. Bilateral dialogues at both official and academic level should be held to discuss their divergent understandings about some of technical and strategic factors surrounding hypersonic technology that are drawing the two countries into a situation of worsening security dilemma.

[128] Mark Stokes, "China's Evolving Conventional Strategic Strike Capability: The Anti-Ship Ballistic Missile Challenge to Us Maritime Operations in the Western Pacific and Beyond," (Washington DC: 2049 Project Institute, 2009).