Hypersonics

Between Rhetoric and Reality

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While it may be an exaggeration to assert the uncontrollable proliferation of hypersonic weapons, many countries are expressing interest in developing these capabilities. Still, the growing interest in hypersonics cannot be a distraction from the development of other more accessible missile technologies, which are at a higher risk of proliferation. And while the label hypersonic must not be used to lure and exhaust the opponent into the arena of strategic competition, France must continue to explore such technology to avoid being caught strategically off-guard. The changes that the deployment of these weapons could introduce into the French national defense strategy must continue to be assessed in both their offensive and defensive dimensions, nuclear as well as conventional, and within all armed services.

From "new lethal weapons" and "spectacular and revolutionary" to "Sputnik moment," there is no shortage of hyperboles to describe current developments in hypersonic technology. It is so much so that on January 4, 2022, an investigation by the French newspaper, *Les Echos*, headlined that this new arms race was likely to "reshuffle the cards of global security."[1] Indeed, 2021 was filled with various new cases. In August, the United States accused China of testing a new disruptive weapon that was capable of circling the earth at low orbit before striking its target. Although Beijing denied this, arguing that it was a test for a reusable space vehicle, US Chairman of the Joint Chiefs of Staff General Mark Milley compared the test to the 1957 launch of the Soviet's Sputnik satellite, which had overtaken the United States in its space conquest by surprise.

In addition, on October 11, 2021, North Korea unveiled a range of weapons at the Defence Development Exhibition, Self-Defence-2021, including a hypersonic glider and a maneuverable reentry vehicle (MaRV) coupled with a new booster named Hwasong-8.[2] Although the glider, flight-tested a few days earlier, generated much doubts about the speed achieved and the actual success of the test, Pyongyang's statements focused solely on the hypersonic feature, thereby generating a viral buzz.

They used this same declaratory strategy during the two tests for a maneuvering reentry warhead on January 6 and January 11. Yet, this was not only similar to what the United States had developed in the 1980s with the Pershing-II missile, but it had also heavily

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1. Anne Bauer, "La course aux armes hypersoniques rebat les cartes de la sécurité mondiale," *Les Echos*, January 4, 2022, https://www.lesechos.fr/.

2. Colin Zwirko, "*New Missiles and Kim Jong Un Idolatry Dominate 'Self-Defense-2021' Expo*," NKPRO, October 12, 2021, https://www.nknews.org/.

referenced China's DF-21D and DF-26 missiles. According to the Korean Central News Agency, during its first test, the warhead accurately hit a target at a distance of 700 km while demonstrating a capacity to move laterally over 120 km once in position.

Finally, Russia claimed on March 19, 2022 that it had used its Kh-47M2 Kinzhal air-launched ballistic missile fired from a modernized MiG-31 to destroy an underground ammunition storage in Ukraine. (This weapon was unveiled in 2018. It has been in operational experimentation on the MiG-31 K since 2020.) While it was a first in combat operations, the strategic messaging mainly focused on the hypersonic nature of this weapon to intimidate NATO. However, the Kinzhal is neither a disruptive weapon nor does it offer Russia a significant operational advantage in the war in Ukraine. Rather, Kinzhal is a modified ground-launched Iskander-M short-range ballistic missile, the latter having been used many times since the beginning of the conflict to create similar military effects.

To focus blindly on the word hypersonic is to forget that a large proportion of ordinary ballistic missiles are already hypersonic, insofar as, depending on their range, they often reach speeds well over five times the speed of sound. In contrast, current technological developments demonstrate the search for maneuverability at very high speeds and under very high aerodynamic constraints in either the upper layers of the atmosphere (gliders, cruise missiles) or during the reentry of a warhead into the atmosphere (MaRVs).

Such efforts must be deciphered in light of the classic dialectic between attack and defense. In such cases, it must aim to increase penetration capabilities in the face of ever more elaborate and integrated missile defenses. Hypersonics thus serve four strategic ambitions. The first is to ensure the credibility of nuclear deterrence for nuclear states. Secondly, hypersonics aim to increase conventional deep precision strike capabilities, which can either support an anti-access posture (Russia and China) or, on the contrary, seek to bypass them through a combination of energy maneuverability (United States).

Finally, they are vectors of strategic signaling that can serve as an intimidation posture (Russia, China, and North Korea). These four strategic ambitions are already supported by more classical missile technologies. In this regard, hypersonics are therefore less of a revolution than an incremental progress in established functions.

Nonetheless, the strategic signaling of various competitors intertwines rhetoric with reality. Hence, the effects on strategic stability should not be overestimated in comparison with other missile technologies already in use. On the one hand, the proliferation of these technologies remains relative to date, given their high level of sophistication; on the other hand, hypersonic weapons do not significantly alter the logic of nuclear deterrence, insofar as the current arsenals already guarantee (and will continue to guarantee for the foreseeable future) the mutual vulnerability of nuclear states.

In this sense, claiming that the United States and its Allies are facing a "Sputnik moment" is exaggerated. Yet, even if these hypersonic weapons do not create new problems, they can certainly amplify existing ones in terms of escalation management, expansion of battlefield space, and the reduction of reaction times, especially when they are serving

opaque and ambiguous doctrines. (The expansion of the battlefield is more significantly related to the increased range of precision weaponry, hypersonic or otherwise.)

A Redefinition of the Dialectic between Attack and Defence

High Speeds for the Energy-Maneuver Ratio

Weapons capable of reaching speeds above Mach 5 already exist as ballistic missiles, whose maximum speed increases with range (up to more than 20 times the speed of sound for ICBMs with a range of over 5,500 km). But their trajectory is predictable: as soon as they are detected, it is relatively easy to determine the point of origin (and therefore to assign responsibility for the attack) and to estimate the ballistic missile's impact point. This is also the case for any space-orbiting vehicle moving at hypersonic speeds along a predictable trajectory. In fact, in order to penetrate elaborate defenses, current developments of weapons capable of speeds above Mach 5 focus instead on using energy to maneuver at very high speeds within the upper atmosphere.

There are two main types of hypersonic weapons. The first is the hypersonic glide vehicle (HGV), which is combined with a ground- or air-launched ballistic missile. Once separated from its booster, it can fly at speeds of around 3 to 5 km/s and at altitudes between 50 and 70 km. These weapons rebound off the atmosphere to increase range and convert their speed into energy for maneuvering. The absence of propulsion, on the other hand, creates a range-penetration dilemma: should the range obtained from the first rebound allow it to maintain a sufficient speed, subsequent maneuvers would then slow it down, exposing the vehicle to the risk of interception at the terminal flight phase.

The second major category is the hypersonic cruise missile (HCM), which is usually powered by a scramjet throughout the flight (supersonic combustion ramjet). These missiles are slower than gliders (around 2 to 2.5 km/s) with generally shorter ranges. Yet, because they fly at lower altitudes (between 30 and 40 km), their detection is even more complicated. They can also maneuver very effectively, especially during their final phase, and can be air-, sea- or ground-launched. On the down side, the development of scramjet technology is not a walk in the park: operating them is akin to "keeping a match lit in the middle of a hurricane," leading certain competitors to initially favor gliders instead in their development of hypersonic weapons.

However, significant progress has been made since then. Today, scramjets have become a key priority for the US Air Force in achieving their large-scale hypersonic strike capability. At the end of 2021, Russia also actively engaged in a testing campaign for their 3M22 Tsirkon hypersonic cruise missile, launched from the *Admiral Gorshkov* frigate and the Severodvinsk submarine. Moscow is thus on the verge of fielding the first scramjet missile, capable of reaching speeds of around Mach 8, several months ahead of its initially

scheduled deadline.[3] Finally, France aims to bring its future ASN-4G missile into service by 2035 for its nuclear deterrent.

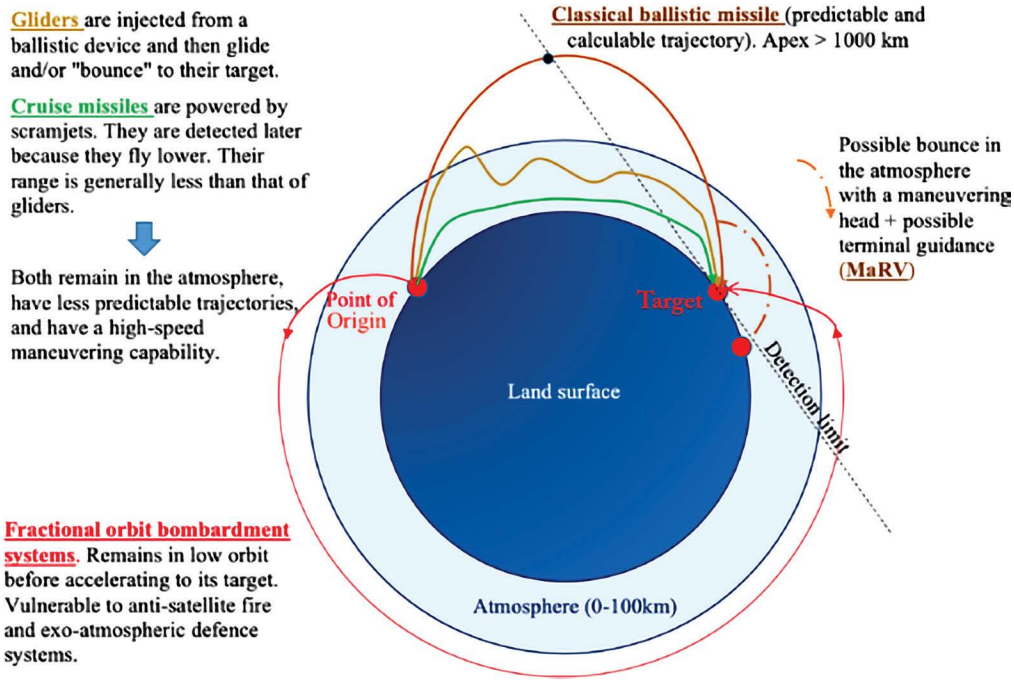

Figure 1: This figure summarizes the different flight profiles and the main characteristics of the hypersonic weapons under consideration (ballistic missiles, maneuvering warheads, HGV, HCM, and FOBS).

Beyond HGV and HCM, two other hybrid categories can be identified. The first are ballistic missiles attached to MaRVs, which can increase the accuracy of terminal guidance and possibly hit slow-moving targets. Iran, China, and North Korea are developing this technology, which is a serious point of concern, particularly in the context of antiship warfare. The second is the Fractional Orbital Bombardment System (FOBS), which has returned to the spotlight with China's testing in the summer of 2021 (although the exact nature of these tests remains unconfirmed).

Unlike gliders that "fly" in the atmosphere, FOBSs circulate in low orbit before performing a reentry maneuver and heading towards their target. The Soviets introduced the first FOBS in 1968 before abandoning them in the 1980s. While they did not contravene the letter of the Outer Space Treaty per se, they evidently contradicted its intended purpose. The 1967 Outer Space Treaty explicitly prohibits the placing weapons of mass

3. "3M22 Zircon," Missile Defense Advocacy Alliance (website), n.d., accessed July 20, 2022, https://missiledefenseadvocacy.org/.

destruction in orbit. Just like ballistic missiles that only pass through space, FOBSs are not legally considered space objects as they do not complete a full orbit around the earth. As such, they do not fall within the scope of space law.

Moreover, FOBSs have limited operational value. Admittedly, they can navigate via the South Pole to evade the northbound-oriented US missile defenses. Yet, the extension of an ICBM's range can also achieve the same capabilities, like Russia's new SARMAT, due to enter into service by 2025. FOBSs also suffer from payload limitations, with reentry into the atmosphere being more difficult to manage. Finally, the use of a low orbit makes their trajectory more predictable than that of gliders or hypersonic cruise missiles.[4] However, coupling a FOBS to a maneuvering reentry body would increase the uncertainty on the final trajectory, as well as on the point of impact.

Increasing Penetration Capacity as an Operational Objective

Beyond the different technologies used, the operational objective remains the same: guaranteeing and increasing the penetration capabilities of offensive systems by thwarting adversary defenses (bypassing) and/or destroying them (suppression). The principles remain the same: converting speed into maneuverability; adopting a flight profile in the higher layers of the atmosphere that are ill-suited to current detection and interception systems; crippling the adversary to the point of paralysis (undermining decision loops); and increasing the unpredictability of trajectories (thus posing an interpretive dilemma).

Four Main Strategic Purposes

Ultimately, the development of hypersonic weapons supports four main purposes, epitomized by the choices of the main hypersonic players today.

1 – Guaranteeing the Credibility of Nuclear Deterrence

The first purpose is ensuring the credibility of exercising nuclear deterrence in the face of an increase in adversary missile defenses. For example, Russia particularly insisted on this rationale as it presented its Avangard system as a response to both US and NATO missile defenses, despite the latter being neither directed at Russia nor designed to counter a large-scale ballistic attack. As an HGV previously known as Project 4202, the Avangard is equipped with a nuclear warhead and can reach speeds of around Mach 20 for maneuvering, thus granting its high penetration capacities. The Avangard is currently carried by the SS-19 Stiletto, pending the entry into service of Russia's new RS-28 Sarmat ICBM by the end of 2025.

The United States believes that China is also using these technologies in a more obscure way as part of an overall modernization effort—both quantitative and qualitative—

4. Emmanuelle Maitre, "Système de bombardement orbital fractionné (FOBS): une nouvelle capacité chinoise?," Observatoire de la Dissuasion, *Bulletin* no. 91 (2021): 6-9, https://www.frstrategie.org/.

for its nuclear deterrent. For example, the test conducted in the summer of 2021 may well have been a glider deployed from an ICBM. Albeit unconfirmed, this hypothesis is more credible today than that of the FOBS due to its few operational advantages, as mentioned above.

France is also moving towards hypersonics, developing a fourth generation air-to-ground nuclear missile (ASN-4G) to be put into service in 2035. In parallel, the V-MAX experimental project aimed at developing a hypersonic glider was granted to the Ariane Group by the French Directorate General of Armaments in 2019. This innovative project aims to develop technological building blocks related to the hypersonic glider, whose future use has yet to be decided (conventional or nuclear). This new maneuvering HCM will guarantee the credibility of the French deterrent's airborne component beyond 2040, while respecting the principle of strict sufficiency.

The United States, on the contrary, seems to not be using hypersonic technology to modernize their nuclear triad, for which Washington has already provisioned more than 27 billion USD by 2022 (Columbia-class nuclear-powered ballistic missile submarine; ground-based strategic deterrent program; B-21 bombers; and AGM-181 long-range stand-off weapon). In particular, it is worth noting that the United States has maintained its focus on stealth and numbers rather than hypervelocity in regard to its nuclear deterrent's airborne component.

2 – Increasing Conventional Deep Precision Strike Capabilities

The second strategic objective consists in improving conventional deep precision strike capabilities (DPS) as coercive tools. This logic was inherited from the US Conventional Prompt Global Strike program, envisioned in 2003 but never realized.[5] The initial objective of this program was to precisely strike any position on the globe in less than an hour with conventionally armed, submarine-launched intercontinental ballistic missiles. This program was put to a halt for two reasons: not only was the cost-effectiveness ratio too detrimental, but the misinterpretation risk for an adversary on the warhead's nature (conventional or nuclear) was also too high, potentially leading to an uncontrollable nuclear escalation.

With the end of the Treaty on Intermediate-Range Nuclear Forces (INF) and the hardening of Russia and China's anti-access/area-denial postures, the United States is now revisiting this concept in light of hypersonic developments in all three services. The US Army is developing the long-range hypersonic weapon (LRHW) "Dark Eagle", which is set to enter into service by 2023. With a range of over 2,000 km, the LRHW uses a ground-launched glider codeveloped with the US Navy, the common-hypersonic glide body (C-HGB). The latter has initiated the Intermediate-Range Conventional Prompt Strike (IRCPS) program, which will integrate the same hypersonic system on

5. Amy F. Woolf, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues*, R41464 (Washington, DC: Congressional Research Service (CRS), July 16, 2021) https://sgp.fas.org/.

Zumwalt-class destroyers from 2023, and on future Virginia-class nuclear attack submarines from 2028.

The US Air Force is still exploring two complementary avenues. The first concerns the development of the AGM-183A air-launched rapid response weapon (ARRW, dubbed "Arrow"). Due to be deployed this year on the B-52, the program is currently experiencing many technical difficulties: the United States suffered a third consecutive failure during the propulsion system's testing on December 15, 2021 from a B-52. This is a further setback for an already backlogged program, and one for which the Air Force had set aside $161 million to buy twelve units in FY22.[6]

While the AGM-183A was planned to be the first operational hypersonic weapon to enter service in the United States, the fiscal 2023 budget has clouded the horizon of the program, canceling procurement in 2023 and reinvesting funds in research and development.[7] Concomitantly, the Air Force has accelerated its scramjet-powered, hypersonic cruise missile program, following the successful flight tests of its hypersonic air-breathing weapon concept (HAWC) demonstrator on September 27, 2021 and in March 2022. The objective is to finalize the design for its future missile, the hypersonic attack cruise missile (HACM), by 2023.

The hypersonic attack cruise missile is set to constitute the Air Force's main airborne hypersonic system by the end of the decade. The contract for the first missile design of the hypersonic air-breathing weapon concept program was awarded in June 2021 to Lockheed and Raytheon (for a period of 15 months). In addition, there is a strong linkage with Australia's Southern Cross Integrated Flight Research Experiment (SCIFIRE) program.

In short, at this stage, the United States is considering a purely conventional application of hypersonic weapons, for which they are not currently considering reaching intercontinental ranges (to avoid ambiguity with their nuclear deterrent). Nevertheless, hypersonics embody the current strategic competition with Russia and China. Washington is thus investing massively to catch up with Moscow and Beijing, as shown by the budget allocated for the 2022 fiscal year in the National Defense Authorization Act ($2.7 billion provisioned, accounting for a 750 percent increase in investments between 2015 and 2020).[8]

For the United States, hypersonic systems have become essential pillars of operational superiority in response to Russia's anti-access/area-denial posture in Europe and China's in Asia. Hypersonics can help reestablish access by neutralizing enemy defenses and, more specifically, the key elements of these postures (detection and command centers, surface-to-air systems, launch sites for the main offensive systems, etc.). This does entail

6. Valerie Insinna, "Air Force Hypersonic Weapon Runs into Trouble after a Third Failed Test," Breaking Defense, December 20, 2021, https://breakingdefense.com/.

7. Valerie Insinna, "Air Force Ditches Plans to Buy First Hypersonic ARRW Missile in FY23," Breaking Defense, March 29, 2022, https://breakingdefense.com/.

8. Kelley M. Sayler, *Hypersonic Weapons: Background and Issues for Congress*, R45811 (Washington, DC: CRS, May 5, 2022), https://sgp.fas.org/.

a risk of escalation, given the entanglement of conventional and nuclear elements in the command, control and intelligence architectures.

3 – Toughen Up Anti-Access Postures

In contrast, the third strategic ambition of hypersonic weapons relates to the strengthening of anti-access postures, as evidenced by Russia and China. Seeking to stun the adversary and strike targets in depth at short notice, the hypersonic systems developed by Moscow and Beijing not only threaten key Allied infrastructures but are also likely to prohibit maneuvering and/or reduce freedom of action.

Anti-access aims to counter the adversary's ability to project power from all domains. By targeting airpower-enabling infrastructures, hypersonic systems can challenge air superiority. They can also contribute to anti-access/area-denial in the maritime domain to keep carrier strike groups' air components—symbolic of US naval supremacy—at bay.

Russia's Tsirkon missile is presented primarily as being antiship with characteristics that could reach its target despite a fleet's layered defense architecture. China's case is even more striking for maritime anti-access. Taking advantage of geography, Beijing has sought to extend its maritime interdiction zone up to the second island chain, including Bonin Island and the Marshall Islands. China has specifically developed MaRV-equipped ballistic missiles: the 1,400 km-range DF-21D and the 4,000 km-range DF-26, known as the "Carrier killer" and the "Guam killer,"respectively.

In addition, in 2019 Beijing officially commissioned the 2500 km-range DF-17 ballistic missile, equipped with a hypersonic glider capable of reaching Mach 10, suggesting an antiship function.[9] In parallel, China is developing a two-stage, antiship, air-launched ballistic missile on its H6-N bomber. Known as the CH-AS-X-13, it is believed to have been developed from the DF-21D surface-to-surface missile, thereby posing an additional threat to opposing naval forces.

Finally, regional powers like North Korea and Iran are also seeking to develop similar capabilities, although they are mainly focused on maneuvering warheads.

4 – A Vector for Strategic Signaling

Beyond posture strengthening, hypersonic weapons are also undoubtedly a tool for strategic signaling. They not only serve as a broader intimidation posture in the context of renewed great power competition, but may also embolden regional powers (Iran and North Korea in particular). Beyond the operational purposes mentioned above, hypersonic weapons also contribute to the prestige of a nation. The current escalation of verbal volleys must also be interpreted from this angle in order to untangle the skein where rhetoric and reality intertwine. This is all the more necessary since a hypersonic strike capability, especially on a moving target, does not only depend on an effector and a

9. CSIS Missile Defense Project, "DF-17," Center for Strategic and International Studies, August 2, 2021.

technological building block. It also requires a highly integrated intelligence, targeting, and command architecture, in which space assets are of paramount importance.

Between Rhetoric and Reality: What Are the Effects on Strategic Stability?

Either a source of concern or hope, the tensions caused by hypersonic vectors in regard to strategic stability are widely discussed in the light of the four previous strategic purposes. They must be analyzed even more carefully because the frenzy over hypersonic technology can be used to endorse both aggressive rhetoric and bureaucratic rationales to secure budgets.

Today, strategic stability can be defined as a situation in which actors are not structurally inclined to choose escalation over restraint. The question is therefore to understand to what extent hypersonic weapons are likely to undermine strategic stability according to its three commonly defined pillars: nuclear stability, crisis stability, and arms race stability.[10]

Perhaps Overestimating the Threat to Nuclear Stability

Following the US disclosure of China's FOBS-like tests carried out in the summer of 2021, US Air Force General John Hyten (then vice chairman of the Joint Chiefs of Staff) accused China of seeking a disarming first strike capability to prevent the United States from retaliating.[11] Tempered a few days later by Secretary of Defense Lloyd Austin, this single statement shows how rhetoric can exaggerate the reality when it comes to hypersonics.

Contrary to Hyten's assertions, the threat of hypersonics to nuclear stability should not be blown out of proportion. The principle of mutual vulnerability, which lies at the heart of deterrence, is already assured by existing means. Indeed, there is already no defense against a complex intercontinental ballistic missile attack, and this situation is unlikely to change.

With only 44 exo-atmospheric interceptors located in Alaska and California, the US homeland missile defense is not suited to counter a saturated attack. In fact, such a composition is only geared towards regional powers, such as North Korea or Iran, with whom the US refuses to concede mutual vulnerability. The same applies to NATO's missile defense as it is only capable of intercepting medium-range ballistic missiles (embodied by four Aegis ships and two Aegis Ashore sites, the first of which has been operational in Romania since 2016 and the second of which is due to be in service in 2023). Furthermore, the second-strike capability of nuclear-powered ballistic-missile submarines is not directly threatened by such developments. In other words, there is most likely not a "Sputnik moment" in today's nuclear stability.

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10. Benjamin. Hautecouverture, Emmanuelle Maitre, and Bruno Tertrais, *The Future of Strategic Stability*, Recherches & Documents, no. 7 (Paris, France: Fondation pour la Recherche Stratégique, 2021), https://www.frstrategie.org/.

11. David Martin, "Exclusive: No. 2 in U.S. Military Reveals New Details about China's Hypersonic Weapons Test," CBS News, November 16, 2021, https://www.cbsnews.com/.

Conversely, one could argue that advances in hypersonic technology are, in fact, beneficial to nuclear stability since they increase the effectiveness of penetrating defenses (qualitative improvements) without oversaturating attacks (quantitative moderation). This is, for example, the path taken by France with its ASN-4G programme, which concurs, as mentioned above, with the strict sufficiency principle.

A Risk to Crisis Stability and Escalation Management

Hypersonic systems, by their intrinsic nature, alter the relationship between time and space by reducing the former (shortened reaction time) and expanding the latter with less trajectory predictability (destination uncertainty), and could therefore complicate escalation management during a crisis. In addition to ambiguous doctrines, hypersonics further exacerbate preexisting risks, forcing the adversary to blindly decide in a two-tiered security dilemma.[12] The first level is an interpretive dilemma due to a double ambiguity. For one, the attack destination remains unclear as it is impossible to determine with certainty the intended target. In the case of two nuclear powers, this ambiguity only raises the adversary's suspicions that a conventional decapitation strike may be meant for its nuclear forces. On the other hand, ambiguity also lies in the warhead's nature, which can be either conventional or nuclear.[13]

Even once this dilemma has been resolved, it gives way to another in which the decision-maker has to tailor his response in an extremely short timeframe. The use of hypersonic weapons can aggravate the response dilemma by aggressively escalating the situation. In order to not lose the strategic advantage conferred by their own offensive systems, the defending belligerent might resort to hypersonics before knowing the outcome of the enemy's strike (the use-it-or-lose-it scenario).

In this context, there is a high risk of misinterpreting the adversary's intentions, which sets the path towards uncontrollable escalation. This is especially the issue if the defender relies on a high alert posture (launch upon warning) and/or grants strong transfers of authority for utilization (including preventive strikes). On the contrary, one may argue that these risks could also incentivize states into maintaining strong political control over the deployment and use of these capabilities in order to prevent undesired escalations.

In sum, the ambiguity at the source of instability lies in doctrine rather than in technologies. For example, China and Russia remain nebulous about the nature of their warheads (hypersonic or otherwise) deployed from their delivery systems, as well as strong obscurity on nuclear or non-nuclear forces. Moreover, the entanglement of conventional and nuclear use in command, control, and intelligence structures already increases the risk of unintended escalation in the event of a conventional strike against one of these

12. Charles-Philippe David et Olivier Schmitt, *La guerre et la paix. Approches et enjeux de la sécurité et de la stratégie* (Paris: Presses de Sciences Po, 2020): 564.

13. Heather Williams, "Asymmetric Arms Control and Strategic Stability: Scenarios for Limiting Hypersonic Glide Vehicles," *Journal of Strategic Studies* 42, no. 6 (2019), https://www.tandfonline.com/.

dual-use components.[14] Therefore, even if hypersonics do not create new problems in escalation management, the use of these weapons could significantly amplify them should there be a tense strategic competition.

Speeding Towards a Hypersonic Arms Race?

Undoubtedly at the onset of a hypersonic arms race, it is still too early to say with certainty that the cards to global security will be significantly reshuffled to the point of disrupting strategic stability. To speak of uncontrollable proliferation seems excessive when the technology needed to operationally field gliders and even more scramjets remains only within the realm of major powers for the time being. Yet, it is true that a growing number of countries' interests have been piqued, independently or in cooperation, as evidenced by the acquisition of MaRVs by regional powers, such as Iran and North Korea.

Moreover, the commotion surrounding hypersonics cannot be a distraction from the development of other more accessible missile technologies. The latter are, in fact, at a higher risk of proliferation, for which there still remains little or no tangible operational response (loitering munitions, drones, conventional cruise missiles, etc.). The label hypersonic must not become the bullfighter's muleta used to lure and exhaust the opponent into the arena of strategic competition. Nevertheless, France must continue to explore such technology to avoid being caught strategically off-guard. The changes that the deployment of these weapons could introduce into the French national defense strategy must continue to be assessed in both their offensive and defensive dimensions, nuclear as well as conventional, and within all armed services. ✈

14. James M. Acton, "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War," *International Security* 43, no.1 (2018), https://direct.mit.edu/.