



RESEARCH ARTICLE

Deciphering Strategic Stability in the Age of Speed: Hypersonic Weapons in South Asia

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In South Asia, India is pursuing an ambitious program to develop Hypersonic Boost-Glide Vehicles (HBGVs) and Hypersonic Cruise Missiles (HCMs). This paper examines India's hypersonic program and analyzes how these weapons may reshape the strategic stability in South Asia. It argues that India's development of hypersonic weapons is unlikely to upend the regional strategic equilibrium. Nevertheless, hypersonic weapons are likely to accelerate India's strategic build-up, thereby undermining strategic stability in South Asia. During a limited military conflict with Pakistan, India would have strong incentives to use hypersonic weapons for "Destruction of Enemy Air Defenses" (DEAD) missions and to strike Pakistan's air bases, conventional missile storage sites, and launch platforms. This would heighten crisis instability by creating serious risks of conventional-nuclear entanglement and raising the risk of nuclear escalation. Furthermore, India's hypersonic weapons would amplify its counterforce temptations by putting at risk land and air components of Pakistan's nuclear triad, thus creating first-strike instability. Consequently, Pakistan would be compelled to undertake measures to augment the survivability of its nuclear arsenal, while India would be continuously seeking to gain the counterforce edge. The unremitting cycle of action and reaction would precipitate instability in the arms race in South Asia.

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Introduction

Nearly a century after they were first conceived, and following years of experimental testing and laboratory demonstrations, hypersonic weapons have become a military reality.¹ Russia and China have operational hypersonic systems, while the US is nearing the deployment of its first hypersonic weapon.² Apart from the three great powers leading the pack, several other countries have hypersonic weapons programs, and more are likely to join the race.³ As technological developments unfold, divergent perspectives have emerged regarding the capabilities and potential implications of hypersonic weapons for strategic balances and military postures. Some accounts have described these weapons as a “game-changing technology” and have warned about the potential of a global arms race.⁴ In contrast, others have doubted the claims about the revolutionary military potential of hypersonic weapons and have termed them “mediocre, calling for the stopping of investments in hypersonic programs.”⁵ In South Asia, the neighboring regional giants, Pakistan and India, shape the

¹ James Acton, “Hypersonic Boost-Glide Weapons,” *Science and Global Security*, Vol. 23, No. 3 (2015), p. 191, <https://doi.org/10.1080/08929882.2015.1087242>.

² See Kelley M. Saylor, “Hypersonic Weapons: Background and Issues for Congress,” Congressional Research Service, August 27, 2025, <https://www.congress.gov/crs-product/R45811>. During the 80th Victory Day parade, China exhibited DF-17, DF-26D, and YJ-21 under “Hypersonic Missile Formation”. Given the long Chinese tradition of displaying only the weapons deployed, these weapon systems can be considered deployed. See, “Full Video: China’s 2025 V-Day Military Parade,” CGTN Europe, September 4, 2025, YouTube Video, 1:32, <https://www.youtube.com/watch?v=6HZNCWr6JT8>. Russia has deployed Avangard, Kinzhal, and Tsirkon hypersonic missiles. See Spenser Warren, “What New Russia Nuclear Weapons Mean,” University of California Institute on Global Conflict and Cooperation, July 30, 2025, <https://ucigcc.org/blog/what-new-russian-nuclear-weapons-mean/#:~:text=Russia's%20New%20Nuclear%20Weapons&text=The%20weapons%20include%20three%20hypersonic,powered%20systems%20remain%20in%20development>. The US is nearing the deployment of its Long-Range Hypersonic Weapon (LRHW), Dark Eagle. See, Kapil Kajal, “1,700 miles in minutes: US Army to field first hypersonic missile battery in December,” *Interesting Engineering*, October 16, 2025, <https://interestingengineering.com/military/us-field-first-hypersonic-battery>.

³ Saylor, “Germany, Australia, France, India, Japan, South Korea, and North Korea have Hypersonic Programs,” Hypersonic Weapons.

⁴ R. Jeffrey Smith, “Hypersonic Missiles Are Unstoppable. And They’re Starting a New Global Arms Race,” *The New York Times Magazine*, June 19, 2019, <https://www.nytimes.com/2019/06/19/magazine/hypersonic-missiles.html>.

⁵ David Wright and Cameron Tracy, “Hypersonic Weapons are Mediocre, It’s Time to Stop Wasting Money on Them,” *Bulletin of the Atomic Scientists*, March 12, 2024, <https://thebulletin.org/2024/03/hypersonic-weapons-are-mediocre-its-time-to-stop-wasting-money-on-them/>.

region's strategic outlook. While Pakistan is not known to have a hypersonic program, India is pursuing an ambitious two-pronged program to develop HCMs and HBGVs. New Delhi's ambitions to build hypersonic weapons date back nearly two decades, and since 2019, it has conducted multiple tests that have yielded mixed results.⁶ In 2020, India announced the successful test of the Hypersonic Technology Demonstrator Vehicle (HSTDV), and another hypersonic missile test was claimed in 2024.⁷ Notwithstanding the mixed results, India's continued investments in the hypersonic program suggest that it may take some time for New Delhi to develop hypersonic weapons. Still, they would eventually become part of South Asia's strategic landscape, with considerable implications for regional strategic stability.

Given the peculiarities of South Asia, the Cold War notion of strategic stability may not be relevant in its standard form and needs to be adapted to align with the region's unique dynamics.⁸ That being so, strategic stability in South Asia can be conceptualized as hinging on the political relationship and military equation between Pakistan and India. At present, the political relationship between Pakistan and India has reached a stalemate, reducing the likelihood that bilateral dialogue will contribute to strategic stability. Along the military equation dimension, India is pursuing a continuous build-up of its conventional and nuclear capabilities, which strains Pakistan's nuclear threshold and creates counterforce threats for its nuclear arsenal, thus having an

⁶ T.S. Subramanian, "DRDO Developing Hypersonic Missile," *The Hindu*, May 9, 2008, <https://web.archive.org/web/20080513092221/http://www.hindu.com/2008/05/09/stories/2008050955301300.htm>.

⁷ Dinakar Peri, "DRDO Successfully Tests Hypersonic Technology Demonstrator Vehicle," *The Hindu*, September 7, 2020, <https://www.thehindu.com/news/national/drdo-successfully-tests-hypersonic-technology-demonstrator-vehicle/article61709465.ece>; Rajnath Singh, "India has achieved a major milestone...", X, November 17, 2024, https://x.com/rajnathsingh/status/1857980534011605222?ref_src=twsrc%5Etfw%7Ctwcamp%5Etweetembe d%7Ctwtterm%5E1857980534011605222%7Ctwgr%5Efab1cf5b03f0a430ec0de40bbe7124d5ca23f938%7Ctwcon%5Es1_&ref_url=https%3A%2F%2Fwww.pib.gov.in%2FPressReleasePage.aspx%3FPRID%3D2073994.

⁸ Colin S. Gray, "Strategic Stability Reconsidered," *Daedalus*, Vol. 109, No. 4 (Fall 1980), pp. 135, <https://www.jstor.org/stable/20024700>.

undermining effect on strategic stability in South Asia. Nevertheless, Pakistan's prudent weapons development to offset the destabilizing impact of India's weapons ensures that strategic equilibrium in South Asia, despite being precarious, is maintained. Given that India's development of hypersonic weapons would significantly bolster its precision-strike and counterforce capabilities, their deployment is likely to have strong reverberations for strategic stability in South Asia.

This paper examines the current outlook and future trajectory of India's hypersonic program and analyzes how the deployment of hypersonic weapons would reshape the region's strategic landscape. It argues that India's hypersonic weapons are unlikely to be a game-changing technology that would turn the strategic balance in South Asia upside down. However, India's development of hypersonic weapons would catalyze ongoing trends in its strategic build-up by significantly bolstering its precision-strike and counterforce capabilities.⁹ India's potential employment of hypersonic weapons in limited military conflicts would heighten crisis-strike instability vis-à-vis Pakistan. In contrast, the counterforce deployment of hypersonic weapons would likely lead to first-strike instability and arms-race instability, thereby undermining strategic stability in South Asia.

This paper comprises six sections, which are subdivided into sub-sections. The first section provides a technological primer by outlining the characteristics of two main types of hypersonic weapons. The second section discusses the conceptual underpinnings of strategic stability. The third section discusses the

⁹ Strategic build-up here refers to India's expansion and modernization of its nuclear arsenal and acquisition of Strategic Non-nuclear Weapons (SNNWs) — the latter category includes hypersonic weapons. For a seminal work on SNNWs.

Andrew Futter and Benjamin Zala, "Strategic Non-Nuclear Weapons and the Onset of a Third Nuclear Age," *European Journal of International Security*, Vol. 6, No. 3 (August 2021), pp. 257–77, <https://doi.org/10.1017/eis.2021.2>. Also see, Ahyousha Khan, "Strategic Non-nuclear Weapons (SNNWs) and Deterrence Stability between Pakistan and India," *Strategic Perspectives*, Vol. 1, No. 2 (Summer 2024), pp. 44–68, <https://strategicperspectives.cissajk.org.pk/strategic-non-nuclear-weapons-snnws-and-deterrence-stability-between-pakistan-and-india/>.

relevance of strategic stability to South Asia and proposes an adapted conceptualization in the regional context. The fourth section deliberates on the state of strategic stability in South Asia and describes it as a precarious equilibrium. The fifth section analyses the current status and future trajectory of India's hypersonic weapon program. The sixth section analyses the potential implications of India's hypersonic weapons for strategic stability in South Asia by discussing their potential employment during limited military conflicts and for counterforce targeting. The paper concludes by summarizing the debate and discussing policy options to maintain strategic stability in South Asia.

Hypersonic Weapons: A Technological Primer

Missiles and other flying vehicles that travel at five times or above the speed of sound ($>Mach\ 5$) are classified as hypersonic weapons.¹⁰ However, this classification based solely on flight velocity can be misleading, since traditional ballistic missiles with ranges above 300 km are hypersonic at burnout and re-enter the Earth's atmosphere at speeds significantly higher than Mach 5.¹¹ However, traditional ballistic missiles follow a fixed parabolic trajectory after their rocket motors burn out, and most of their flight occurs outside the atmosphere (Figure 1).¹² The largely predictable trajectory of ballistic missiles makes them vulnerable to interception by Ballistic Missile Defense (BMD) systems.¹³ The latest category of hypersonic missiles combines hypersonic

¹⁰ Mach 5 is roughly equal to 6,174 km/h or 4,000 mph. See, James Acton, "Hypersonic Weapons Explainer," Carnegie Endowment for International Peace, 2 April 2018, <https://carnegieendowment.org/posts/2018/04/hypersonic-weapons-explainer?lang=en>.

¹¹ Dean Wilkening, "Hypersonic Weapons and Strategic Stability," *Survival*, Vol. 61, No. 5 (2019), pp. 129-130, <https://doi.org/10.1080/00396338.2019.1662125>; James Acton (@james_acton32), "If 'hypersonic' is defined as speed $> Mach\ 5...$," X, September 17, 2024, 12:17 AM, https://x.com/james_acton32/status/1835759875642507723.

¹² James Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike*, (Washington: Carnegie Endowment for International Peace, 2013), p. 5.

¹³ The guided versions of ballistic missiles are only capable of limited terminal maneuverability during the re-entry phase, which is enabled by a terminal (mostly inertial) guidance system. In addition, the guided missiles achieve maneuverability using externally fitted canards and fins or by adjusting the position of the RV's center of gravity with the movement of a weight inside the RV, or by employing additional thrusters. See, Markus Schiller, "Missile Identification and Assessment," *International Institute of Strategic Studies*, (2022), p. 4,

speeds and low-altitude flight within the atmosphere with long-range maneuverability, significantly enhancing their ability to circumvent most missile defenses and engage targets with high precision¹⁴ The hypersonic weapons can be classified into two major categories¹⁵.

Hypersonic Boost Glide Vehicles (HBGVs)

BGVs are launched into space using the same rocket boosters that are used to launch ballistic missiles.¹⁶ However, unlike ballistic missiles, HBGVs have a short ballistic phase and re-enter the Earth's atmosphere soon after, and glide hundreds of kilometers unpowered using aerodynamic lift generated by their unique shape before diving on their target.¹⁷ The flight path of an HBGV can be divided into six phases: 1) boost, 2) ballistic, 3) re-entry, 4) pull-up, 5) glide, and 6) terminal. In the boost phase, a rocket booster accelerates the missiles carrying the BGV to hypersonic velocity until the rocket motor burns out and the Re-entry Vehicle (RV) is separated from the booster. In the ballistic phase, also called the exo-atmospheric phase, the RV travels in a short ballistic trajectory above the Earth's atmosphere. In the re-entry phase, the RV re-enters the atmosphere under the Earth's gravitational pull. In the pull-up phase, RV

www.iiss.org/globalassets/media-library---content--migration/files/research-papers/2022/04/missile-identification-and-assessment.pdf.

¹⁴ Richard H. Speier, George Nacouzi, Carrie A. Lee, Richard M. Moore, *Hypersonic Missile Nonproliferation: Hindering the Spread of a New Class of Weapons* (Santa Monica: RAND Corporation, 2017), pp. 1-4.

¹⁵ A third category of hypersonic weapon systems that can achieve hypersonic speeds and are capable of maneuverability is Maneuverable Re-entry Vehicles (MaRVs). For MaRVs, the ballistic phase makes most of the flight trajectory. However, these missiles re-enter the atmosphere relatively early compared to a traditional ballistic missile and glide within the atmosphere for a relatively short duration before diving at their target. MaRVs are capable of maneuverability during the glide and re-entry phases, which means they have improved accuracy than normal ballistic missiles. During a conversation with the author, James Acton (Co-Director of Nuclear Policy Program at Carnegie Endowment for International Peace) classified MaRVs as hypersonic systems. James Acton, Virtual Interview to the author, October 22, 2025. For a detailed discussion on MaRVs, see, David Wright and Cameron L. Tracy, "Hypersonic Weapons: Vulnerability to Missile Defenses and Comparison to MaRVs," *Science and Global Security*, Vol. 31, No. 3 (2023), pp. 2-5, <https://doi.org/10.1080/08929882.2023.2270292>.

¹⁶ Wilkening, "Hypersonic Weapons," 130.

¹⁷ BGVs can be of a variety of shapes; the most common shapes are wave-rider or wedge, and conical. See, Cameron L. Tracy and David Wright, "Modeling the Performance of Hypersonic Boost-Glide Vehicles," *Science and Global Security*, Vol. 28, No. 3 (2020), p. 137, <https://doi.org/10.1080/08929882.2020.1864945>.

slowly rotates to assume a high-lift, low-drag flight position, reducing the path angle and entering a stable glide trajectory.¹⁸ Hence, during the glide phase, the path angle is approximately zero, and the aerodynamic lift enables the equilibrium gliding. Finally, the missile dives down towards its target during the terminal phase.¹⁹

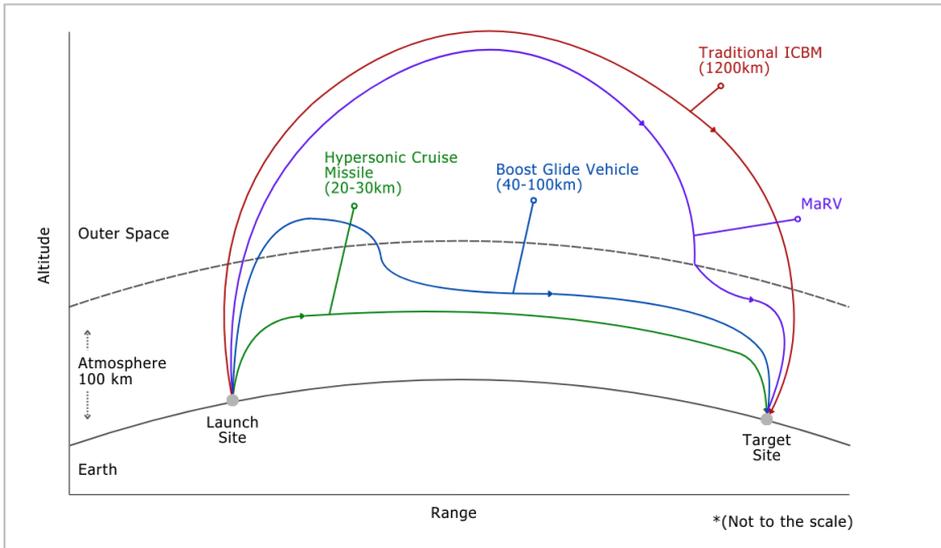


Figure 1. A Comparison of Trajectories of a Traditional ICBM, HBGV, MaRV, and HCM. (Note: The author extends thanks to James Acton for his insightful input during the development of this figure.)

The HBGVs travel through the atmosphere during the glide and terminal phases, which form most of their flight. During the two stages, the HBGV flight is governed by atmospheric drag, and the range is determined by the glide vehicle's lift-to-drag (L/D) ratio.²⁰ The atmospheric air density provides adequate lift for the HBGV to achieve sustained flight. However, the lift is inevitably accompanied by proportional atmospheric drag, leading to a drop in

¹⁸ The path angle is defined as the angle between the velocity vector of the RV and the local horizontal. See Acton, "Hypersonic Boost-Glide Weapons," p. 196.

¹⁹ For a detailed discussion on the different phases of the flight path of BGVs, see Ibid, 198.

²⁰ Ibid, 193; Tracy and Wright, "Modeling the Performance," p. 142.

flight altitude and a reduction in velocity of the HBGVs, which compromises their range, maneuverability, and delivery time.²¹ Any horizontal maneuver further decreases the speed of HBGVs; however, a vertical maneuver, such as a skip-glide or inverted dive, can enable an HBGV to accelerate.²² HBGVs have a delivery-time advantage over ballistic missiles fired along Minimum Energy Trajectories (METs). But, they are unable to outmatch the short delivery time of ballistic missiles launched at Depressed Trajectories (DTs).²³

Given the low altitude of HBGVs' flight (usually less than 50 km), they are subject to intense, sustained heating due to the higher atmospheric density at these altitudes. The heating of BGVs' bodies puts limits on their performance and poses the foremost technical challenge in developing longer-range missiles.²⁴ The low-altitude flight of HBGVs, however, means they remain undetectable to most ground-based radar systems for most of their flight.²⁵ However, satellite-mounted infrared (IR) sensors can detect the bright rocket plumes produced during the launch of HBGVs using rocket motors. Moreover, during the glide phase, the strong infra-red signature generated by BGVs—owing to the extreme temperatures of the glider's surface and the resulting heating of air molecules surrounding the vehicle—makes them detectable to

²¹ For a detailed discussion on the hypersonic flight, see David Wright & Cameron Tracy, "The Physics and Hype of Hypersonic Weapons," *Scientific American*, August 1, 2021, <https://www.scientificamerican.com/article/the-physics-and-hype-of-hypersonic-weapons/>. Also see Tracy and Wright, "Modeling the Performance," pp. 142-143.

²² Tracy and Wright, "Modeling the Performance," pp. 140, 147; Kolja Brockmann and Dmitry Stefanovich, *Hypersonic Boost-Glide Systems and Hypersonic Cruise Missiles: Challenges for Missile Technology Control Regime* (Stockholm: Stockholm International Peace Research Institute, 2022), p. 6.

²³ Tracy and Wright, "Modeling the Performance," pp. 146-147.

²⁴ The warheads mounted on normal ballistic missiles also experience extremely high heating during the re-entry phase. However, the re-entry phase for such missiles is usually very short, i.e., ranging from less than a minute to a few minutes depending on trajectory and range. On the contrary, the within-atmosphere glide for hypersonic missiles could be as long as 30 minutes, which means that they have to sustain the thermal effects for most of their flight. The heating challenge is more profound for HCMs, which fly at even lower altitudes. See, *Hypersonic Weapons and Alternatives*, (Washington: Congressional Budget Service, 2023), p. 8, www.cbo.gov/system/files/2023-01/58255-hypersonic.pdf.

²⁵ The line-of-sight of land-based radars is limited by the Earth's curvature beyond a few hundred kilometers. See Tracy and Wright, "Modeling the Performance," p. 149.

satellite-mounted IR sensors.²⁶ The low flight altitude of BGVs means that currently operational Ballistic Missile Defense (BMD) systems designed for exo-atmospheric interceptions cannot intercept HBGVs during their glide phase. Moreover, missile defenses with high-end-to-low exo-atmospheric operational altitude windows are incapable of engaging HBGVs during the glide phase. They are not well-suited for interception during the ballistic or re-entry phase.²⁷ Currently, operational terminal missile defenses engage targets at altitudes below 40 km and thus can only defend small areas. HBGVs during their dive phase may be vulnerable to these endo-atmospheric interceptors, which must be capable of attaining 2-3 times the lateral acceleration of the maneuvering target.²⁸ Moreover, to evade current missile defense systems, HBGVs must be able to maintain speeds significantly exceeding Mach 5 during the whole course of the glide phase, and the speed of the RV throughout the dive phase should be substantially greater than that of the interceptor.²⁹

Hypersonic Cruise Missiles (HCMs)

HCMs—also called ‘air-breathing cruise missiles’—are fitted with scramjet engines, which power them throughout the course of their flight. Scramjet engines burn hydrocarbon fuel by consuming atmospheric oxygen as the air passes through the combustion chamber at supersonic speed.³⁰ Hence, unlike

²⁶ Wright, Tracy, “Hypersonic Weapons are Mediocre.” Also see, Tracy and Wright, “Modeling the Performance,” pp. 149-152.

²⁷ For details, see Wright and Tracy, “Hypersonic Weapons,” 8-9; Tracy and Wright, “Modeling the Performance,” p. 159.

²⁸ Research has found that to evade the most capable currently deployed missile defense systems, such as PAC-3 MSE (speed Mach 6 and interception altitude 30+ km), a BGV should maintain a speed greater than Mach 6 during its dive phase, which means that the dive phase must start at a speed greater than Mach 10. Since other terminal interceptors, such as PAC-3 CRI or ship-based SM-2 and SM-6, have even less speed, they are unlikely to be effective against a BGV capable of maintaining such speed. For detailed discussion, see Wright and Tracy, “Hypersonic Weapons,” pp. 10-15.

²⁹ *Ibid.*, 37.

³⁰ The operation of a scramjet engine is a highly challenging process to achieve and sustain. The air stays in the combustion chamber for less than a millisecond, and during this ultra-short duration, the air must efficiently mix with the hydrocarbon fuel, which must ignite and fully burn. Hence, the scramjet operation is compared with “lighting a match in a hurricane and keeping it burning”. See “X-51 Waverider makes historic hypersonic flight,” Air Force Material Command, last modified May 26, 2010,

rockets, on-board oxidizers are not required for HCMs, which reduces their overall mass.³¹ Since HBGVs flying through the atmosphere encounter considerable drag, which compromises their overall performance, the HCMs might provide an attractive alternative, given that scramjet engines enable these missiles to maintain constant hypersonic speed throughout the flight. However, since scramjet engines operate only at speeds greater than Mach 4, HCMs must initially be accelerated to near-hypersonic speeds by a rocket booster before the scramjet can take over propulsion.³² Hence, the overall mass of an HCM is the sum of the masses of its hypersonic vehicle and the rocket booster.

The HCMs currently under development have an intrinsic speed constraint that limits their flight to the low hypersonic range, i.e., up to Mach 7. The speed limitation stems from the use of hydrocarbon fuel (jet fuel), whose energy output above Mach 7 or 8 is insufficient to produce sufficient thrust. An alternative option is to use hydrogen fuel, which yields almost three times the energy output of jet fuel and has very short ignition and burn durations. However, the much lower density of hydrogen fuel compared to jet fuel means that a much larger volume of hydrogen would be required to produce similar thrust. This means that a hypersonic vehicle powered by hydrogen fuel would be significantly larger and would inevitably incur higher drag, which could compromise the vehicle's ability to achieve a high thrust-to-drag ratio.³³ The operation of the scramjet engine imposes limits on the trajectories of HCMs. The requirement to intake sufficient oxygen for on-board combustion means that HCMs must fly at low altitudes (20-30 km) through dense air, which

<https://www.afmc.af.mil/News/Article-Display/Article/154198/x-51-waverider-makes-historic-hypersonic-flight/>.

³¹ For a detailed discussion on the functioning of Hypersonic Airbreathing Missiles, see, David M. Van Wie, Stephen M. D'Alessio, and Michael E. White, "Hypersonic Airbreathing Propulsion," *Johns Hopkins APL Technical Digest*, Vol. 26, No. 4, (2005), pp. 430-436.

³² Congressional Budget Office, "U.S. Hypersonic Weapons and Alternatives," January 31, 2023, <https://www.cbo.gov/publication/58255>.

³³ David Wright and Cameron L. Tracy, "Hypersonic Cruise Missiles," *Science and Global Security*, Vol. 32, No. 1-3, (2024), pp. 223-224, <https://doi.org/10.1080/08929882.2024.2447176>.

drastically constrains their ability to maintain flight at high altitudes.³⁴ Flying through the dense atmosphere means hypersonic vehicles experience higher drag, leading to high fuel consumption and limiting the overall range of HCMs.³⁵ Hence, achieving very long ranges for HCMs poses insurmountable technological challenges. Moreover, the strong functional relationship between the design of a hypersonic vehicle and its characteristics, such as speed, flight altitude, and range, underscores the design efficiency challenges for HCMs.³⁶

The comparatively lower speeds of HCMs (only up to Mach 7) mean longer flight durations compared to HBGVs and Maneuverable Re-entry Vehicles (MaRVs) for the same distance. Most importantly, at such low speeds, HCMs would not be fast enough to evade the currently operational most advanced missile defense system, PAC-3 MSE.³⁷ Hence, although HCMs have an advantage in evading the enemy's land-based early warning systems owing to their low flight altitude, in the presence of space-based sensors, these missiles might not be a viable option to neutralize missile defenses with characteristics comparable to PAC-3 MSE. Apart from strike missions, HCMs are envisioned to be employed for surveillance and intelligence-gathering, owing to their low-altitude flight and their maneuverability throughout the flight. HCMs have greater maneuverability than HBGVs, primarily because of their low speeds, which require less force to turn. However, Wright and Tracy argue that if the objective is to leverage midcourse maneuverability, then supersonic cruise missiles might be a more viable option, given their greater maneuverability and use of more efficient and reliable ramjet or turbojet engines.³⁸ HCMs, HBGVs,

³⁴ Brockmann and Stefanovich, *Hypersonic Boost-Glide Systems and Hypersonic Cruise Missiles*, 7.

³⁵ For example, to extend the range of a hypersonic vehicle like the US X-51A, more than 1 ton of fuel would be required, which would not only mandate re-designing the missile but also strengthening the structure to carry such large quantities of fuel. For details, see, Wright and Tracy, "Hypersonic Cruise Missiles," 255.

³⁶ The design for HCMs must be optimized to achieve a high drag-to-lift ratio, i.e., staying aloft at high speeds while generating low drag. See, *Ibid*, 224-225.

³⁷ To evade PAC-3 MSE, the hypersonic weapon must be able to maintain speeds of Mach 9 or 10 during its terminal phase, i.e., while diving at its target. For details, see, *Ibid*, 222.

³⁸ *Ibid*, 257-258.

and MaRVs are also capable of maneuverability during their terminal phases, which enables them to improve accuracy, dodge missile defense, and re-target, potentially by hundreds of kilometers.³⁹

Strategic Stability: The Conceptual Underpinnings

The concept of strategic stability evolved during the Cold War as an intellectual product of thinking about the aftermath of the nuclear revolution, the challenges posed by the fear of surprise attack, the employment strategies of nuclear weapons, and the conditions necessary for credible nuclear deterrence.⁴⁰ Above all, the fear of a surprise attack stemming from the vulnerability of nuclear forces motivated the thinking, which led to the formulation of the notion of strategic stability.⁴¹ In 1946, Bernard Brodie and William Borden published their books examining the aftermath of nuclear revolution. Brodie highlighted the annihilation risk to the cities by nuclear weapons and famously called for averting wars through the capability to retaliate in kind.⁴² On the contrary, Borden predicted that the US adversaries would soon acquire nuclear weapons, making nuclear war an inevitability. In such a war, he argued, the primary role for nuclear weapons would be to launch disarming first strikes.⁴³ While Borden's work highlighted the foremost challenge to strategic stability, i.e., the possibility of a surprise attack targeting nuclear forces, Brodie outlined one of the key remedies, i.e., the capability for assured

³⁹ Ibid, 243.

⁴⁰ Michael S. Gerson, "The Origins of Strategic Stability: The United States and the Threat of Surprise Attack," in *Strategic Stability: Contending Interpretations*, ed. Elbridge Colby and Michael S. Gerson (Carlisle: U.S. Army War College Press, 2013), p. 3.

⁴¹ Ibid, 5.

⁴² Bernard Brodie, "War in the Atomic Age," in *The Absolute Weapon: Atomic Power and World Order*, ed. Bernard Brodie (Connecticut: Yale Institute of International Studies, 1946), pp. 6-14, 50.

⁴³ William Liscum Borden, *There will be No Time: The Revolution in Strategy* (New York: Macmillan Press, 1946).

retaliation. Considered together, the work by Brodie and Borden laid the substratum for the intertwining theories of nuclear deterrence and strategic stability.

In 1959, RAND expert Albert Wohlstetter published “The Delicate Balance of Terror,” which examined the “stability of thermonuclear balance.” Wohlstetter believed that deterrence after the dawn of the nuclear age “is not automatic” and underlined that thermonuclear weapons provided a considerable advantage in striking first. He argued that the vulnerability of nuclear forces to surprise attack means that the nuclear balance remains “delicate”. Wohlstetter further argued that the stability of deterrence rested on the assured capability to strike back after absorbing a first strike and “guaranteeing great damage” to the adversary.⁴⁴ While Wohlstetter’s article mainly focused on deterrence and briefly discussed stability, Harvard Professor Thomas Schelling made stability the central subject of his work.⁴⁵ Schelling believed that the most significant incentive to launch a surprise attack is the “fear of being a poor second” and underscored that the probabilities of striking first are compounded by the “reciprocal fear” that the other side may be about to initiate a first strike.⁴⁶ Schelling argued that to prevent a nuclear war, not only must each side be confident about its ability to launch a second strike, but also that it could not eliminate the adversary’s ability to strike back. Mutual deterrence, Schelling argued, requires the “stability of balance, which can only be achieved when neither side, in a first strike, can eliminate the adversary’s ability to strike back. For Schelling, if both sides are confident of their ability to strike back, not only

⁴⁴ Albert Wohlstetter, “The Delicate Balance of Terror,” *Foreign Affairs*, Vol. 37, No. 2, (Jan 1959), pp. 211-234, <https://doi.org/10.2307/20029345>.

⁴⁵ In 1959, Thomas Schelling wrote an article, *Surprise Attack and Disarmament*, in the *Bulletin of Atomic Scientists*. A year later, Schelling published his landmark book, *The Strategy of Conflict*, which featured a revised version of the article and a full chapter on “The Reciprocal Fear of Surprise Attack”. See, Thomas Schelling, “Surprise Attack and Disarmament,” *Bulletin of Atomic Scientists*, Vol. 15, No. 10, (1959), pp. 413-418, <https://doi.org/10.1080/00963402.1959.11454030>; Thomas Schelling, *The Strategy of Conflict* (Cambridge, London: Harvard University Press, 1960).

⁴⁶ Schelling, *The Strategy of Conflict*, pp. 218-220, 231.

will there not be an “advantage in jumping the gun, but also the fear that the other side might try it would be eliminated.”⁴⁷

Most importantly, Schelling identified the interplay between the surprise attack and weapons designed for a first strike. He distinguished defensive weapons (that can only target cities) from offensive weapons (customized to destroy the adversary’s nuclear assets). He underscored that defensive weapons eliminate the incentives to launch a first strike, while offensive weapons increase the temptation to do so.⁴⁸ Schelling argued that to address the first strike problem and reduce the risk of nuclear war, offensive weapons should be the focus of disarmament efforts or arms control limitations.⁴⁹ Schelling’s work is regarded as groundbreaking in the development of the theory of strategic stability and had a tremendous impact on the evolution of strategic theory.⁵⁰ The concept of strategic stability served as a benchmark for evaluating security in the nuclear age and as the theoretical foundation for the Cold War arms control agreements.⁵¹ Furthermore, Schelling’s recognition of the connection between the challenge of first-strike and first-strike weapons provided the foundation for broadening the scope of strategic stability from the initial, narrow considerations of achieving crisis stability to include arms-race stability. Later scholars further refined and advanced the two notions as the conceptual underpinnings of strategic stability.⁵²

⁴⁷ Ibid, pp. 232-233.

⁴⁸ Ibid, pp. 233, 240-241.

⁴⁹ Ibid, pp. 231, 241.

⁵⁰ Schelling’s second book, *Arms and Influence*, further deliberated on the drivers behind the surprise attack and identified “the premium on haste” as “the greatest source of danger” leading towards a nuclear war. See, Thomas Schelling, *Arms and Influence*, (New Haven and London: Yale University Press, 2020), p. 227.

⁵¹ Gerson, “The Origins of Strategic Stability,” p. 35.

⁵² Colin S. Gray defined crisis stability as a condition wherein “instruments of war (mechanical, electronic, organizational) should not be the immediate cause of war” during the periods of crisis. Likewise, he defined arms race stability as a situation wherein neither side “will press military developments or deployments in quest of major advantage, because such advantage is judged to be unattainable, however desirable”. Elbridge Colby defines first strike stability as a situation “when both parties would see that massively launching first — whether to avoid being neutered or to try to disarm one’s opponent would be either unnecessary or foolish”. He defines arms race stability to be a situation when “each side’s arms developments were manifestly designed to conform to the enduring reality of mutual vulnerability rather than as plausible attempts to gain strategic

Among multiple explanations, James Acton put forth the most compelling conceptualizations of strategic stability and its underlying notions. Acton defines crisis stability as a condition wherein “neither side has nor perceived incentives to use nuclear weapons first out of the fear that the other side is about to do so. Likewise, he defines arms race stability to be “the absence of perceived or actual incentives to augment a nuclear force—qualitatively or quantitatively—out of fear that in a crisis an opponent would gain a meaningful advantage by using nuclear weapons first”.⁵³ Acton argues that arms race stability and crisis stability are not two distinct concepts but are essentially manifestations of the same phenomenon on different timescales. Hence, Acton conceptualizes strategic stability to be a situation wherein “neither party has or perceives an incentive to change its force posture out of concern that an adversary might use nuclear weapons first in a crisis.”⁵⁴ Importantly, Acton argues that a holistic conceptualization of strategic stability must include conventional weapons capable of targeting an adversary’s nuclear forces or Command-and-Control (C&C) structures.⁵⁵ Colin S. Gray and Dale Walton consider the “weapons-oriented” conceptions to be too narrow and hence flawed.⁵⁶ They categorize the military dimension as only one part of the immensely complicated strategic stability problem and advocate a “holistic” conception that includes political, social, economic, and technological trends, among others.⁵⁷ Gray and Walton argue that strategic stability reflects the “overall condition of the international system” and caution that assessing the

superiority”. Colby defines strategic stability as “a situation in which no party has an incentive to use nuclear weapons” except to deter or in response to a major aggression against “its vital interests in extreme circumstances”. See, Gray, “Strategic Stability Reconsidered”; Elbridge Colby, “Defining Strategic Stability: Reconciling Stability and Deterrence,” in *Strategic Stability: Contending Interpretations*, ed. Elbridge Colby and Michael S. Gerson (Carlisle: U.S. Army War College Press, 2013), pp. 48-49, 55.

⁵³ James M. Acton, “Reclaiming Strategic Stability,” in *Strategic Stability: Contending Interpretations*, ed. Elbridge Colby and Michael S. Gerson (Carlisle: U.S. Army War College Press, 2013), p. 121.

⁵⁴ *Ibid.*, p. 128.

⁵⁵ *Ibid.*, p. 123.

⁵⁶ C. Dale Walton and Colin S. Gray, “The Geopolitics of Strategic Stability: Looking Beyond Cold Warriors and Nuclear Weapons,” in *Strategic Stability: Contending Interpretations*, ed. Elbridge Colby and Michael S. Gerson (Carlisle: U.S. Army War College Press, 2013), p. 85.

⁵⁷ *Ibid.*, p. 109.

system's stability can be rather challenging.⁵⁸ While characterizing the real strategic stability “a Platonic ideal—which remains unachievable as a policy goal—the two categorize it as a useful standard to judge the real-world challenges.⁵⁹

Strategic Stability: Relevance to South Asia

The strategic discourse in South Asia draws heavily on the strategic theory developed during the Cold War. However, given the stark differences between Cold War dynamics and South Asia’s strategic landscape, applying standard Cold War conceptualizations remains challenging and may be impracticable in some cases.⁶⁰ Hence, several voices have advocated developing a South Asian notion of strategic stability, and there have been few attempts to reconceptualize strategic stability to adapt to the region's unique dynamics.⁶¹ Nevertheless, despite the efforts at customization and adaptation, Cold War-era literature has deep imprints on strategic stability discourse in South Asia. While South Asian scholars and officials often use the term “strategic stability” to describe the regional nuclear dyad, there is a stark lopsidedness in its use among the actors involved. The term "strategic stability" receives little mention in India’s official discourse and is debated only marginally in

⁵⁸ Ibid, p. 90.

⁵⁹ Ibid, p. 93.

⁶⁰ S. Paul Kapur, “India and Pakistan’s Unstable Peace: Why Nuclear South Asia is not Like Cold War Europe,” *International Security*, Vol. 30, No 2, (Fall 2005), pp. 127-152, <https://doi.org/10.1162/016228805775124570>; Maryam Zubair, “Indo-Pak Nuclear Dynamics: Why Cold War Lessons May Not Apply,” *South Asian Voices*, April 10, 2018, <https://southasianvoices.org/indo-pak-nuclear-dynamics-why-cold-war-lessons-may-not-apply/>.

⁶¹ “Nuclear Deterrence and Strategic Stability: Relevance in South Asia,” Strategic Vision Institute, streamed live on Aug 26, 2025, YouTube video, <https://www.youtube.com/watch?v=0Y-aHxAgPcM>. Also see, Sameer Ali Khan, “Exploring the Meaning of Strategic Stability in South Asian Context,” Center for Aerospace and Security Studies Working Paper, June 2023, https://www.researchgate.net/publication/372006894_Exploring_the_Meaning_of_Strategic_Stability_in_the_South_Asian_Context; Adil Sultan, “Reconceptualizing Strategic Stability in South Asia,” *Strafasia*, July 26, 2025, <https://strafasia.com/reconceptualizing-strategic-stability-in-south-asia/>.

Indian academic literature. However, the concept features prominently in Pakistan's official and semi-official discourse and is frequently discussed in scholarly literature. The asymmetrical use of the term in Indian and Pakistani discourses reflects divergences in the strategic priorities of the two countries: while Pakistan seeks to stabilize the South Asian nuclear dyad, India has shown little interest in pursuing strategic stability and appears to be seeking strategic superiority. Hence, it is not surprising that most of the literature on strategic stability in South Asia originates from Pakistani sources.

In one of the earliest works on nuclear stability in South Asia, Feroz Hassan Khan described stability in strategic and technical terms. Strategic stability, Khan maintains, is "ensuring safety, security, and survivability of nuclear weapons." In technical terms, Khan argued, stability refers to configuring nuclear C&C to guarantee a credible second-strike retaliatory capability.⁶² While Khan's account emphasizes survivability and second-strike capability for strategic stability, S. Paul Kapur accentuates the escalation dimension. He conceptualizes strategic stability in terms of the likelihood of a conventional conflict escalating to involve the use of nuclear weapons. He argues that stability would entail a low probability that conventional hostilities would escalate to the nuclear level.⁶³ In his seminal work on strategic stability in South Asia, Naeem Salik relies primarily on the Cold War conceptualization. He outlines three factors undercutting strategic stability in South Asia: 1) crisis instabilities, 2) arms race instabilities, and 3) escalatory dangers. He further underscores South Asia's own peculiarities and interactions with extra-regional

⁶² Feroz Hassan Khan, "Challenges to Nuclear Stability in South Asia," *The Non-proliferation Review*, Vol. 10, No 1, (Spring 2003), p. 62, <https://doi.org/10.1080/10736700308436917>.

⁶³ Kapur, "India and Pakistan's Unstable Peace," pp. 1-2.

actors as additional factors shaping strategic stability in the region.⁶⁴ In a recent work on the same subject, Naeem Salik uses the same framework. He highlights Strategic Non-Nuclear Weapons (SNNWs) and India's domestic politics as additional factors affecting the strategic landscape in South Asia.⁶⁵ While outlining an Indian perspective on strategic stability, Gurmreet Kanwal also employs the Cold War model by conceptualizing strategic stability as a derivative of crisis stability, deterrence stability, and arms race stability. Nevertheless, presumably to adapt the concept in the South Asian context, Kanwal highlights the backdrop of hostility between India and Pakistan in the bilateral relationship, owing to outstanding territorial disputes, as affecting strategic stability.⁶⁶

In his articulation of a Pakistani perspective on strategic stability, Zahir Kazmi defines the term as “the fruit of the relationship between India and Pakistan that encompasses the political conditions, security circumstances, doctrines, and force postures that mutually preserve peace, prevent crisis escalation, and resolve disputes to reduce the risk of war—especially a nuclear exchange.”⁶⁷ Elsewhere, Kazmi describes strategic stability as a situation in which Pakistan is confident that India is serious about resolving territorial disputes, and India's strategic partnerships and cooperation with major world powers do not impinge on Pakistan's security.⁶⁸ Kazmi's inclusion of territorial disputes and India's global partnerships within the strategic stability fold

⁶⁴ Naeem Salik, “Strategic Stability in South Asia: Challenges and Prospects,” *Islamabad Papers*, Nuclear Paper Series No. 3, (February 2016), pp. 4-9, <https://issii.org.pk/wp-content/uploads/2016/02/Nuclear-Paper-Series-No.-3.pdf>.

⁶⁵ Naeem Salik, “Recalibrating Strategic Stability: Lessons from May 2025 for a Multi-Domain Warfare,” in *Strategic Reckoning: Perspectives on Deterrence and Escalation Post-Pahalgam – May 2025*, ed. Rabia Akhtar (Islamabad: CSSPR-IRS, 2025), pp. 103-107.

⁶⁶ Gurmreet Kanwal, *Strategic Stability in South Asia: An Indian Perspective*, (Springfield: Sandia National Laboratories, 2017), p. 13, www.sandia.gov/app/uploads/sites/148/2021/07/sand2017-4791-2.pdf.

⁶⁷ Zahir Kazmi, “South Asian Strategic Stability: A Pakistani Perspective,” International Institute of Strategic Studies, April 4, 2017, YouTube video, 6:20, <https://www.youtube.com/watch?v=xFs1W4kU3Mo&t=2580s>.

⁶⁸ Zahir Kazmi, “SRBMs, Deterrence and Regional Stability in South Asia: A Case Study of Nasr and Prahaar,” *Regional Studies*, Vol. 30, No 4, (Autumn 2012), p. 75, <https://regionalstudies.com.pk/wp/wp-content/uploads/2022/11/4.-SRBMs-DETERENCE-STABILITY-IN-S.ASIA-Zahir-Kazmi.pdf>.

underscores a more inclusive conceptualization that accounts for the dynamics of the political relationship between India and Pakistan and the involvement of extra-regional powers, beyond the traditional weapons-oriented and crisis-escalation models of strategic stability.

At the official level, the statements released after the meetings of Pakistan's National Command Authority (NCA) allude to discriminatory practices regarding the global non-proliferation regime, and conventional and nuclear build-up by India as factors undermining strategic stability in South Asia.⁶⁹ While the NCA regularly emphasizes dialogue to resolve outstanding disputes, it has at least once designated conflict resolution as the means to achieve strategic stability.⁷⁰ Although some NCA statements highlight Pakistan's desire for strategic stability in the region through a cooperative framework, the NCA has avowed that Islamabad will take all necessary measures to maintain strategic stability in South Asia, without getting entangled in an arms race with India.⁷¹ Advisor to NCA, Lt. Gen. Khalid Ahmed Kidwai (Retd), conceptualizes strategic stability to include not just nuclear stability, but as a "wholesome concept" encompassing "many elements of national power and strategy". Kidwai further states that in the face of India's hegemonic designs, arms build-up, and repeated efforts to destabilize the strategic balance, Pakistan shoulders

⁶⁹ Inter Services Public Relations, "Press Release No. PR-166/2011-ISPR," ISPR, last modified July 14, 2011, <https://ispr.gov.pk/press-release-detail?id=1796>; Inter Services Public Relations, "Press Release No. PR-615/2017-ISPR," ISPR, last modified December 21, 2017, <https://ispr.gov.pk/press-release-detail?id=4459>; National Command Authority, "25th Meeting of the National Command Authority (NCA) was held under the chairmanship of Prime Minister Imran Khan at Headquarters Strategic Plans Division on 8 September 2021," Prime Minister's Office, last modified September 8, 2021, https://www.pmo.gov.pk/news_details.php?news_id=1140.

⁷⁰ The 21st NCA meeting stated Pakistan's position that it considers conflict resolution as the mean to achieve strategic stability and lasting peace in the region. See, Inter Services Public Relations, "Press Release No. PR-280/2015-ISPR," ISPR, last modified September 9, 2015, <https://ispr.gov.pk/press-release-detail?id=3026>.

⁷¹ The 22nd NCA meeting reiterated Pakistan's long desire to establish a Strategic Restraint Regime in South Asia, and the 23rd NCA meeting declared that Pakistan "will endeavor to work with its neighbors to ensure strategic stability in South Asia." The 25th NCA meeting held in 2021, however, avowed that Pakistan would undertake all necessary steps to maintain strategic stability in the region, without joining an arms race. See, Inter Services Public Relations, "Press Release," ISPR, last modified February 24, 2016, <https://ispr.gov.pk/press-release-detail?id=3211>; Inter Services Public Relations, "Press Release No. PR-64/2016-ISPR," ISPR, December 21, 2017; "25th Meeting of the National Command Authority."

the responsibility of maintaining strategic stability in South Asia by undertaking offsetting measures to deny India any advantage.⁷² The avowal by NCA and Kidwai's assertion that Pakistan should shoulder the responsibility for maintaining strategic balance in South Asia reflects Islamabad's frustration with achieving strategic stability with India through a cooperative framework. It suggests a unilateral pursuit to maintain strategic equilibrium, which conceptually aligns more closely with the operationalization of deterrence than with typical strategic stability. Based on the above discussion, strategic stability in South Asia can be conceptualized as a function of the political relationship and the military balance between Pakistan and India. Along the political dimension, strategic stability hinges on the state of the bilateral relationship between Pakistan and India. A stable strategic situation entails resolving bilateral disputes and ensuring that disputes do not trigger military crises—or, at the very least, that crises do not escalate into nuclear risks (crisis instability).⁷³ From the military equation standpoint, strategic stability refers to a situation wherein the conventional or nuclear arms acquisitions (arms race instability) by either state reinforce the mutual vulnerability and do not alter the strategic balance to create first-strike incentives (first-strike instability), or strain nuclear thresholds to create compulsions for nuclear use (deterrence instability).⁷⁴

⁷² Lt. Gen. Khalid Ahmed Kidwai (Retd), "South Asian Strategic Stability: Deterrence, Nuclear Weapons and Arms Control," International Institute of Strategic Studies, February 6, 2020, *YouTube Video*, 1:05, <https://www.youtube.com/watch?v=bInVdvk39e0>.

⁷³ The addition of the political dimension is in line with the inclusive conceptualization by Dale Walton and Colin S. Gray and serves the purpose of adapting the concept of strategic stability to the South Asian context. See, Walton and Gray, "The Geopolitics of Strategic Stability," 109.

⁷⁴ This conceptualization of strategic stability draws on the Cold War notion of strategic stability by considering crisis instability and arms race instability as the main pillars. However, given that conventional asymmetry in South Asia is directly linked to nuclear weapons thresholds, at least on the Pakistani side, an inclusive conception of strategic stability must include the conventional military balance between India and Pakistan, which should not significantly widen to strain Islamabad's nuclear threshold(s).

Strategic Stability in South Asia: A Precarious Equilibrium

Strategic stability in South Asia remains precarious due to a range of factors across the political and military dimensions of the India-Pakistan relationship.

Outstanding Disputes Triggering Military Crises

Pakistan and India have several outstanding disputes, including those over Jammu and Kashmir, Sir Creek, and water resources.⁷⁵ The most intricate is the Jammu and Kashmir dispute, which has been a trigger for two major wars and at least one border war.⁷⁶ The dawning of the nuclear age in South Asia may have closed the door on major wars, but the simmering nature of the Kashmir dispute and the peculiar conflict dynamics have remained consistent triggers for crises and limited military conflicts between the two neighbors.⁷⁷ Lately, the military conflicts have expanded in scope and grown in intensity to feature the use of airpower and precision missile strikes deep inside each other's territories and targeting high-profile military installations.⁷⁸ Alarming, the conflict pattern suggests that each conflict sets a baseline for the next, entailing almost exponential growth in the intensity of each new crisis. Grave as they are, the disputes involve inherent risks for uncontrolled escalation and heightened crisis instability, thereby imperiling strategic stability.

⁷⁵ Stephen P. Cohen, *Shooting for a Century: The India-Pakistan Conundrum*, (Washington DC: Brookings Institution Press, 2013), pp. 33-59.

⁷⁶ For detailed accounts of the Kashmir conflict, see Alastair Lamb, *Kashmir: A Disputed Legacy 1846-1990*, (Karachi: Oxford University Press, 2021); Victoria Schofield, *Kashmir in Conflict: India-Pakistan and the Unending War*, (London, New York: I.B. Tauris, 2021); Sumantra Bose, *Kashmir at the Crossroads: Inside a 21st Century Conflict*, (New Haven and London: Yale University Press, 2021).

⁷⁷ The Indian Prime Minister Narendra Modi has vowed that India will conduct military strikes against Pakistan after each militant attack in Indian Occupied Jammu & Kashmir (IOJ&K) or elsewhere. The avowal not only creates a dangerous commitment trap for Modi to act more aggressively after each attack but also is tantamount to outsourcing the crisis trigger to non-state actors. See, Naeem Salik, "Recalibrating Strategic Stability," 107.

⁷⁸ Mujib Mashal, "What We Know About How the 4-Day India-Pakistan Clashes Unfolded," *The New York Times*, May 11, 2025, <https://www.nytimes.com/2025/05/11/world/asia/india-pakistan-what-we-know.html>.

Diplomatic Stalemate between Pakistan and India

Despite the presence of bilateral disputes involving serious risks, which underscore the urgency of dialogue, a tense diplomatic stalemate prevails between India and Pakistan. The two states have not held formal dialogue since 2008, and even the on-and-off talks have collapsed after 2015.⁷⁹ Since 2019, the two countries have downgraded diplomatic ties twice, marking possibly the lowest point in bilateral relations in decades.⁸⁰ The breakdown of dialogue minimizes the possibility of dispute resolution to address the root causes of the conflicts. Besides, it hampers progress on some low-hanging fruit, such as establishing crisis management mechanisms or agreeing on Confidence-Building Measures (CBMs) to prevent crisis escalation or enable crisis de-escalation.⁸¹ Most importantly, the absence of dialogue for such an extended period is likely to cause a depreciation of institutional memory regarding each other's evolving worldviews and positions on core issues, which would make holding meaningful conversations much more challenging, even if dialogue resumes.

⁷⁹ The Composite Dialogue Process (CDP) between India and Pakistan was disrupted after the 2008 Mumbai attacks, and up until late 2015, several efforts were made to resume the dialogue, which failed to reach fruition. See, Baqir Sajjad Syed, "Breakthrough at 'Heart of Asia': Pakistan, India to Resume 'Comprehensive' Talks," *Dawn*, December 10, 2015, <https://www.dawn.com/news/1225402/breakthrough-at-heart-of-asia-pakistan-india-to-resume-comprehensive-talks>; Kamran Yousaf, "Pakistan, India Talks Deferred After Pathankot Attack," *The Express Tribune*, January 10, 2016, <https://tribune.com.pk/story/1027429/pakistan-india-talks-deferred-after-pathankot-attack>.

⁸⁰ In 2019, Pakistan downgraded diplomatic ties with India after New Delhi revoked the special status of the disputed Jammu and Kashmir under its control. Pakistan withdrew its High Commissioner and expelled the Indian Envoy, besides suspending the bilateral trade. In 2025, following the Pahalgam attack, India further downgraded diplomatic ties, which Islamabad reciprocated. See, Pamela Constable, "Pakistan Downgrades Diplomatic Ties, Suspends Trade with India over Kashmir Move," *The Washington Post*, August 7, 2019, https://www.washingtonpost.com/world/pakistan-downgrades-diplomatic-ties-suspends-trade-with-india-over-kashmir-changes/2019/08/07/6ea88c8a-b919-11e9-8e83-4e6687e99814_story.html; Eltaf, Najafizada, Sudhi Ranjan Sen and Kamran Haider, "Pakistan Hits Back at India as Kashmir Fallout Widens," *Bloomberg*, April 24, 2025, <https://www.bloomberg.com/news/articles/2025-04-24/pakistan-hits-back-at-india-by-expelling-diplomats-halt-trade>.

⁸¹ In the Pakistan-India context, the crisis management role has traditionally been outsourced to third parties. However, given that the Indian PM Modi faced domestic backlash for accepting President Trump's mediation during the Four-Day Conflict and India rejected President Trump's repeated claims of stopping the Pakistan-India war, moving forward, crisis management in South Asia by third parties is likely to become increasingly challenging. See, Moeed Yusuf, *Brokering Peace in Nuclear Environments: U.S. Crisis Management in South Asia* (Stanford: Stanford University Press, 2018).

Indian Leadership's Dismissiveness of Nuclear Revolution

Soon after the introduction of nuclear weapons in South Asia, India started contemplating limited conventional war options to circumvent Pakistan's nuclear thresholds.⁸² However, after failing to operationalize the limited war doctrine, India adopted a limited conventional strikes doctrine.⁸³ While previously it was about skirting around Pakistan's nuclear redlines, the Indian leadership has lately grown dismissive of Pakistan's nuclear capability. After the recent Four-Day military conflict, Prime Minister Narendra Modi asserted that India proved Pakistan's "nuclear threats" to be "falsehoods."⁸⁴ The Indian Defense Minister implied that India could undo the creation of nuclear-armed Pakistan, while India's Army Chief threatened to erase Pakistan from the map.⁸⁵

⁸² The first discussions on limited war were held during a seminar on "The Challenge of Limited War: Parameters and Options" at the Institute of Defense Studies and Analyses (IDSA) on January 5-6, 2000. India's then Defense Minister George Fernandes declared, "Nuclear weapons do not make war obsolete but simply impose another dimension on the way warfare could be conducted." He further argued, "India has understood the dynamics of limited war after it declared its nuclear weapons status." The limited war concept later evolved into the Cold Start doctrine. See, Ali Ahmad, "India's Limited War Doctrine: The Structural Factor," IDSA Monograph Series No. 10 (December 2012), p. 27, <https://www.idsa.in/system/files/Monograph10.pdf>; Swaran Singh, "Indian Debate on Limited War Doctrine," *Strategic Analysis*, Vol. 23, No 12, (March 2000), p. 2180, <https://doi.org/10.1080/09700160008455190>; Walter C. Ladwig III, "A Cold Start for Hot Wars: Indian Army's Limited War Doctrine," *International Security*, Vol. 32, No. 3, (Winter 2007/08), pp. 158-190, <https://doi.org/10.1162/isec.2008.32.3.158>. For a critical analysis of the Cold Start doctrine and escalation risks it entails, see Naeem Salik, "Cold Start: The Cat is Out of Bag," *CISS Insight*, Vol. 4, No. 4 (2016), pp. 1-16, <https://journal.ciss.org.pk/index.php/ciss-insight/article/view/64/61>.

⁸³ Pakistani officials credit the development of the Short Range Ballistic Missile (SRBM) Nasr under its Full Spectrum Deterrence (FSD) policy for deterring India's limited war doctrine. India operationalized its Limited Conventional Strikes doctrine during the 2019 Balakot crisis and during the 2025 Four-Day Conflict with Pakistan. See Baqir Sajjad Syed, "Nasr Pours Cold Water on India's Cold Start Doctrine: Bajwa," *Dawn*, July 6, 2017, <https://www.dawn.com/news/1343581>; Kidwai (Retd), "South Asian Strategic Stability," 5:05.

⁸⁴ "India Called Pakistan's Nuclear Bluff, Some of Their Airbases Still in ICU: PM Modi on Op Sindoor," *News18*, July 29, 2025, <https://www.news18.com/india/india-called-pakistan-nuclear-bluff-some-of-their-airbases-still-in-icu-pm-modi-on-op-sindoor-9471562.html>; Chandrajit Mitra, "'India Won't Tolerate Nuclear Blackmail': PM Modi's Big Message to Pakistan," *NDTV*, August 15, 2025, https://www.ndtv.com/india-news/independence-day-2025-pm-narendra-modi-on-indus-waters-treats-says-india-wont-tolerate-nuclear-blackmail-by-pakistan-9089402?utm_source=chatgpt.com.

⁸⁵ For the Indian Defense Minister's statement, see "Op Sindoor Just Trailer, Every Inch of Pak Now Within BrahMos' Range: Rajnath Singh," *NDTV*, October 18, 2025, <https://www.ndtv.com/india-news/every-inch-of-pakistan-now-within-brahmos-range-operation-sindoor-was-just-trailer-rajnath-singh-9478347>. For the Indian Army Chief's statement, see Chandrajit Mitra, "'Will Erase from Map, Won't Exercise Restraint': Army Chief Warns Pakistan," *NDTV*, October 3, 2025, <https://www.ndtv.com/india-news/will-erase-from-map-wont-exercise-restraint-army-chief-warns-pakistan-9389206>.

Although Pakistan's nuclear thresholds remain ambiguous, the undoing of the creation and the erasure from the map certainly breach Pakistan's nuclear redlines. Such rejection of the nuclear revolution in South Asia creates dangerous commitment traps for Indian leadership. It creates incentives to act more aggressively and unrestrainedly during a crisis, thereby risking deliberate or inadvertent crossing of Pakistan's nuclear redlines.⁸⁶

India's Conventional Military Build-Up

India has been making considerable investments to expand and modernize its conventional military capabilities.⁸⁷ India's defense spending nearly doubled from \$47.4 billion in 2013 to reach \$86.1 billion by 2024.⁸⁸ For over a decade, India has been the world's second-largest arms importer, accounting for 8.3% of global arms imports during 2020-2024 and 9.1% during 2015-2019.⁸⁹ India is also boosting its domestic defense industrial base under "Make in India", which is aimed at building India's military technological base and reducing its reliance on defense imports.⁹⁰ Given that Pakistan faces an almost 2:1

⁸⁶ For the theory of nuclear revolution, see Robert Jervis, *The Meaning of Nuclear Revolution: Statecraft and the Prospect of Nuclear Armageddon* (New York: Cornell University Press, 1989).

⁸⁷ For a detailed account of India's conventional military modernization, see, Walter C. Ladwig III, "India's Military Modernization and Conventional Deterrence in South Asia," *The Journal of Strategic Studies*, Vol. 38, No. 5, (2015), pp. 729-772, <https://doi.org/10.1080/01402390.2015.1014473>; Masood Ur Rehman Khattak, "India's Military Modernization: Implications for Pakistan," *Strategic Studies*, Vol. 39, No. 1, (2019), pp. 20-40, <https://issii.org.pk/indian-military-modernisation-implications-for-pakistan/>.

⁸⁸ Sam Perlo-Freeman and Carina Solmirano, "Trends in the World's Military Expenditure, 2013," *SIPRI Fact Sheet*, April 2014, <https://www.sipri.org/sites/default/files/files/FS/SIPRIFS1404.pdf>; Xiao Liang, Nan Tian, Diego Lopes da Silva, Lorenzo Scarazzato, Zubaida Karim, and Jade Guiberteau Ricard, "Trends in the World's Military Expenditure, 2024," *SIPRI Fact Sheet*, April 2025, https://www.sipri.org/sites/default/files/2025-04/2504_fs_milex_2024.pdf.

⁸⁹ Pakistan is ranked as the fifth-largest arms importer, accounting for 4.6% of global arms imports. See, Mathew George, Katarina Djokic, Zain Hussain, Pieter D. Wezeman, and Siemon T. Wezeman, "Trends in International Arms Transfers, 2024," *SIPRI Fact Sheet*, March 2025, https://www.sipri.org/sites/default/files/2025-03/fs_2503_at_2024_0.pdf.

⁹⁰ Government of India, "Marching Towards Atmanirbharta: India's Defense Revolution," Government of India, *Press Information Bureau*, October 29, 2024, <https://www.pib.gov.in/PressNoteDetails.aspx?NotelD=153377&ModuleId=3®=3&lang=1>; Mahendra Ved, "Defense Industries: How Successful of 'Make in India'?" *The Secretariat*, January 10, 2025, <https://thesecretariat.in/article/defence-industries-how-successful-is-make-in-india>.

conventional asymmetry with India, it has to either undertake corresponding conventional procurements or enhance its reliance on nuclear weapons to offset India's overwhelming advantage.⁹¹ With a defense spending of merely \$10.2 billion in 2024, Pakistan cannot balance India's military superiority through conventional military means alone. This is likely to compel Islamabad to enhance its reliance on nuclear deterrence, which could cause a lowering of its nuclear threshold and might increase the risk of nuclear escalation.⁹²

India's Strategic Build-Up and Counterforce Temptations

India is also undertaking a significant build-up of its strategic arsenal and is calibrating its force posture for counterforce targeting against Pakistan.⁹³ Estimates suggest that India now possesses more nuclear weapons than Pakistan and has an expanding potential to produce thousands more warheads.⁹⁴ Moreover, India is increasing the number and range of its land-based missiles, significantly improving their accuracy, and equipping them with Maneuverable Independently Targetable Re-entry Vehicles (MIRV) technology, thereby accentuating the possible counterforce role of these systems.⁹⁵ Besides, India

⁹¹ For military capabilities of India and Pakistan, see International Institute of Strategic Studies *The Military Balance – 2025* (London: Routledge, 2025), pp. 251-257 & 286-291. Also see Zafar Khan, "Growing Conventional Asymmetry between India and Pakistan," *Pakistan Horizon*, Vol. 73, No. 3/4, (2020), pp. 89-106, <https://pakistan-horizon.piia.org.pk/index.php/pakistan-horizon/article/view/140/136>.

⁹² After the Four-Day War in May 2025, several voices have argued that the Pakistan military's performance shattered the myth of its conventional inferiority vis-à-vis India. Undoubtedly, Pakistan has maintained a qualitative military edge over India, which is rightfully credited for the recent successes. However, qualitative edge could be decisive during limited military conflicts where the quantitative factor is largely irrelevant. In a prolonged conflict, quantitative edge can come into play and might enable a crucial advantage.

⁹³ India rationalizes its nuclear build-up by claiming to strengthen its second-strike capability vis-à-vis China. However, the capabilities that are acquired to bolster second-strike vis-à-vis China can be used in a counterforce role against Pakistan. See Christopher Clary and Vipin Narang, "India's Counterforce Temptations: Strategic Dilemmas, Doctrine, and Capabilities," *International Security*, Vol. 43, No. 3 (Winter 2018/19), pp. 27-28, https://doi.org/10.1162/isec_a_00340.

⁹⁴ In January 2025, India and Pakistan are estimated to have 180 and 170 nuclear weapons, respectively. See Hans M. Kristensen and Matt Korda, "World Nuclear Forces," in *SIPRI Year Book: Armaments, Disarmaments and International Security*, (Oxford: Oxford University Press, 2025), pp. 181-182. For India's weapons-usable unsafeguarded fissile material stockpiles and plan to expand fissile material production capacity, see Mansoor Ahmed, *India's Nuclear Exceptionalism: Fissile Materials, Fuel Cycles, and Safeguards* (Cambridge: Belfer Center for Science and International Affairs, 2017).

⁹⁵ For the numbers and ranges of Indian missiles, see Hans M. Kristensen, Matt Korda, Eliana Johns, and Mackenzie Knight, "Indian Nuclear Weapons, 2024," *Bulletin of the Atomic Scientists*, Vol. 80, No. 5 (2024), pp. 331-334, <https://doi.org/10.1080/00963402.2024.2388470>. India's Agni-Prime missile (which is believed

has developed an array of short and medium-range ballistic and cruise missiles, which are claimed to be highly precise and thus purpose-built for counterforce targeting.⁹⁶ Almost all of India's missiles are dual-capable, and some have been assigned a conventional role, which creates conventional-nuclear "entanglement."⁹⁷ India is also undertaking a significant expansion of its sea-based nuclear arsenal. The testing profiles and reported features of India's Submarine-Launched Ballistic Missiles (SLBMs) suggest possible counterforce features.⁹⁸ In addition, India has reconfigured its nuclear C&C system to enhance responsiveness and now maintains a significant portion of its nuclear arsenal at a high state of readiness.⁹⁹ Furthermore, India is steadily bolstering

to be Pakistan-specific) is reported to have a Circular Error Probable (CEP) of 10 meters, See, Rahul Bedi, "India test-launches New Agni-series Nuclear-capable missiles," *Janes*, June 28, 2021, <https://www.janes.com/osint-insights/defence-news/india-test-launches-new-agni-series-nuclear-capable-missile>. For an analysis of the MIRVing of India's missiles, see, Hamdan Khan, "What Does India's Demonstration of MIRV Technology Mean for Strategic Stability in South Asia," *We News*, March 30, 2024, <https://weneenglish.com/what-does-indias-demonstration-of-mirv-technology-mean-for-strategic-stability-in-south-asia/>.

⁹⁶ India's short-range missiles include the 150-km Prahara (ballistic), the 400-km Pralay (quasi-ballistic), and the 450-500-km BrahMos (supersonic cruise). The medium-range missiles include 1,000-km Nirbhay (subsonic cruise) and 700-1,000-km Shaurya (Ballistic). All of these missiles are claimed to be highly precise and are well-suited for a counterforce role. See, Clary and Narang, "India's Counterforce Temptations," pp. 29-30. The development of India's 800-km BrahMos, which is tailor-made for counterforce targeting, is nearing completion. See, Rajat Pandit, "Upgrading Strike Capability: India Tests 800-km BrahMos," *Times of India*, October 20, 2025, <https://timesofindia.indiatimes.com/india/upgrading-strike-capability-india-tests-800-km-brahmos/articleshow/124694864.cms>. The flight tests of Pralay were conducted in July 2025. See, "DRDO Successfully Conducts Two Flight Tests of Pralay Missile," Government of India, Press Information Bureau, July 29, 2025, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2149610>.

⁹⁷ For a seminal work on entanglement, see James M. Acton, "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raise the Risk of an Inadvertent Nuclear War," *International Security*, Vol. 43, No. 1 (Summer 2018), pp. 56-99, https://doi.org/10.1162/isec_a_00320. India has used BrahMos in a conventional role, while media reports claim that India is customizing its longest-range missile, Agni-V, for a conventional role to target underground-hardened bunkers. See, Shivani Sharma, "India's Agni-5 'bunker buster' missiles to carry largest conventional warhead," *India Today*, June 30, 2025, <https://www.indiatoday.in/india/story/after-us-iran-strikes-india-accelerates-bunker-buster-missile-project-2748410-2025-06-30>.

⁹⁸ Ghazala Yasmin Jalil, "India's Development of Sea-Based Nuclear Capabilities: Implications for Pakistan," *Strategic Studies*, Vol.38, No. 1, (Spring 2018), pp. 40-41, <https://issii.org.pk/indias-development-of-sea-based-nuclear-capabilities-implications-for-pakistan/>. For a recent account of India's sea-based nuclear capability and future projects, see, Hamdan Khan "Atoms for Ambitions: Unpacking the Drivers behind India's Nuclear Buildup," *Strafasia*, August 16, 2025, <https://strafasia.com/atoms-for-ambition-unpacking-the-drivers-behind-indias-nuclear-build-up/>. For a discussion on counterforce characteristics of India's K-15 and K-5 SLBMs, see Clary and Narang, "India's Counterforce Temptations," pp. 27-28.

⁹⁹ India has canonized a large portion of its land-based missiles, particularly Agni-Prime and Agni-V, and recently tested the rail-mobile version of Agni-Prime, indicating a high state of readiness for India's arsenal. See, "DRDO Carries out the Successful Launch of Intermediate Range Agni-Prime Missile from a Rail based Mobile Launcher System," Government of India, Press Information Bureau, September 25, 2025, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2170979>; "Successful Test-Firing of 'Agni 5' Intermediate Range Ballistic Missile," Government of India, Press Information Bureau, August 20, 2025,

its integrated Intelligence, Surveillance, and Reconnaissance (ISR) capabilities, which are central to target acquisition and missile accuracy, thus a qualification for counterforce.¹⁰⁰ Finally, yet importantly, India is pursuing an ambitious BMD program, which stimulates counterforce temptations by creating a delusional sense of security.¹⁰¹ India's ongoing and potential nuclear build-up suggests that the country is seeking strategic superiority over Pakistan, with counterforce as its centerpiece.¹⁰²

Strategic Equilibrium Precarious but Sustaining

Although on the political side, Pakistan has little leverage to reshape the Indian leadership's behavior or bring New Delhi to the negotiating table, it has been pursuing a carefully calibrated strategy along the weapons equation dimension to maintain strategic balance in South Asia. While India's conventional and nuclear buildup unsettles the strategic equilibrium, Islamabad undertakes countervailing arms developments in both conventional and nuclear domains. Owing to its resource constraints and relatively modest nuclear program, Pakistan can barely afford to

<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2158574>; Clary and Narang, "India's Counterforce Temptations," pp. 36-38.

¹⁰⁰ Clary and Narang, "India's Counterforce Temptations," pp. 31-36; Amjad Mahmood and Adil Sultan, "Impact of India's ISR on South Asian Security Dynamics," *Strategic Studies*, Vol. 14, No. 4, (Winter 2021), pp. 17-39, https://issi.org.pk/wp-content/uploads/2022/02/2-SS_Amjad_Mahmood_and_Adil_Sultan_No-4_2021.pdf; Rajat Pandit, "Post Op Sindoore, India to Fast-Track Launch of 52 Defense Surveillance Satellites," *Times of India*, June 30, 2025, <https://timesofindia.indiatimes.com/india/post-op-sindoor-india-to-fast-track-launch-of-52-defence-surveillance-satellites/articleshow/122149971.cms>.

¹⁰¹ Zafar Khan, "India's Ballistic Missile Defense: Implications for South Asian Deterrence Stability," *The Washington Quarterly*, Vol. 40, No. 3 (2017), pp. 187-202, <https://doi.org/10.1080/0163660X.2017.1370339>; Hamdan Khan, "What do India's Ballistic Missile Defense Ambitions Mean for Strategic Stability in South Asia?" *We News*, August 15, 2024, <https://wenewsenglish.com/what-do-indias-ballistic-missile-defense-ambitions-mean-for-strategic-stability-in-south-asia/>. During his Independence Day speech on August 15, 2025, the Indian PM announced the "Sudarshan Chakra" to provide "complete security cover" to all the important places in India by 2035. See, Rajat Pandit, "Mission Sudarshan Chakra: Multi-layered Air and Missile Shield Integrated with Offensive Weapons," *Times of India*, August 16, 2025, <https://timesofindia.indiatimes.com/india/mission-sudarshan-chakra-multi-layered-air-missile-shield-integrated-with-offensive-weapons/articleshow/123328590.cms>.

¹⁰² Michael Krepon, *The Logic of Nuclear Superiority*, Stimson Center, April 18, 2018, <https://www.stimson.org/2018/logic-nuclear-superiority/>.

mirror all of India's weapon developments. Therefore, Islamabad's strategy hinges on smart investments in weapon systems that can offset the strategic fallout of India's arms buildup and deny New Delhi any strategic advantage under its policy of Full Spectrum Deterrence (FSD) within the precincts of Credible Minimum Deterrence (CMD).¹⁰³ Hence, despite its precariousness, the strategic equilibrium in South Asia is sustaining, i.e., has not upended.

India's Hypersonic Program: Current Status and Future Trajectory

India's pursuit of hypersonic weapons development dates back roughly two decades. In 2008, V.K. Saraswat—then head of Research and Development (R&D) at India's Defense Research and Development Organization (DRDO)—revealed that India is working on an HSTDV project, intending to develop a scram-jet engine capable of flight at 15-20 km altitude.¹⁰⁴ In June 2019, the first test of HSTDV reportedly failed to achieve the anticipated results.¹⁰⁵ The media reports attributed the failure to the malfunctioning of the rocket booster, which was unable to boost the HSDTV to the required altitude for the start of scramjet operation.¹⁰⁶ In September 2020, the second test of HSTDV was

¹⁰³ Pakistan's development of the MIRVed missile Ababeel is regarded as a response to India's BMD pursuit. See, Inter Services Public Relations, "Press Release, No PR-34/2017-ISPR," ISPR, last modified January 24, 2017, <https://ispr.gov.pk/press-release-detail?id=3705>. In addition, Pakistan's development of sea-based nuclear capability, which is claimed to have enabled the "successful attainment of second strike capability," is attributed to India's nuclear force posture moving towards counterforce. See, Inter Services Public Relations, "Press Release No. PR-10/2017-ISPR," ISPR, last modified January 10, 2017, <https://ispr.gov.pk/press-release-detail?id=3672>.

¹⁰⁴ Subramanian, "DRDO Developing Hypersonic Missile."

¹⁰⁵ Abhishek Bhalla, "India's Maiden Hypersonic Speed Flight Test Under Cloud. Vague DRDO Statement Triggers Debate," *India Today*, June 12, 2019, <https://www.indiatoday.in/india/story/india-gets-success-in-scamjet-demonstrator-aircraft-test-1547537-2019-06-12>.

¹⁰⁶ Agni-1 SRBM was used as a rocket booster. See, Kapil Kajal, "India Test-Flies Hypersonic Technology Demonstrator," *Janes*, February 2, 2023, <https://www.janes.com/osint-insights/defence-news/defence/india-test-flies-hypersonic-technology-demonstrator-vehicle>.

conducted and was officially proclaimed a success. The official press release stated that the cruise vehicle successfully separated from the rocket booster at hypersonic speed at an altitude of 30 km, and the air intake started as intended.¹⁰⁷ Regarding scramjet operation, it was announced that fuel injection and auto-ignition were validated and that combustion sustained at hypersonic flow, enabling the vehicle to cruise for more than 20 seconds at Mach 6. Moreover, the test was claimed to have validated several critical technologies, including the vehicle's aerodynamic configuration for hypersonic maneuverability and the thermo-structural properties of materials capable of withstanding high temperatures.¹⁰⁸

Notwithstanding DRDO's history of making exaggerated claims, if the publicized performance indicators are considered authentic, the test can be regarded as an elementary success for DRDO, reflecting the technical capability to implement the fundamental principles of highly complex scramjet operation. However, a 20-second flight at Mach 6, which theoretically would enable the vehicle to travel roughly 40 km, is not adequate for an operational weapon system.¹⁰⁹ Although short-duration flights in early scramjet tests are quite normal, the challenges related to scramjet operation, the vehicle's aerodynamics, and the material's thermo-structural properties multiply manifold for longer-duration hypersonic flights.¹¹⁰ Not only is scramjet combustion

¹⁰⁷ The media reports suggested that Agni-1 SRBM was again used as a rocket booster.

¹⁰⁸ Government of India, "DRDO Successfully Flight Tests Hypersonic Technology Demonstrator Vehicle," Government of India, Press Information Bureau, September 7, 2020, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=1651956>. For an explanation of thermo-structural properties, see *Thermo-Structural Analysis Manual* (Ohio: Flight Dynamics Laboratory, Directorate of Material and Processes, Air Force Systems Command, 1962), <https://apps.dtic.mil/sti/tr/pdf/AD0286908.pdf>.

¹⁰⁹ Considering Mach 1 = 0.343 km/s at sea level, travelling at Mach 6 for 20 seconds, the distance covered by the cruise vehicle would be 41.16 km. However, it is worth noting that the speed of sound is not constant and varies with altitude; e.g., at 30 km altitude, Mach 1 is 0.3017 km/s.

¹¹⁰ The longer duration here means a few minutes. The scramjet operation for the first two successful hypersonic flights of NASA's X-43A hypersonic research vehicle in 2004 lasted for roughly 10 seconds. See, NASA, "X-43A Hyper-X," NASA, last modified Jan 5, 2024, <https://www.nasa.gov/reference/x-43a/#hds->

prone to self-combustion, but the increase in speed and extended flight duration pose multiplying design, heating, and aerodynamics-related challenges, making longer-duration hypersonic cruise flights highly complicated.¹¹¹ In January 2023, the third flight test of HSTDV was conducted. No official statement was issued following the test, and DRDO declined to share the details.¹¹² Media reports suggested that the boost phase was successful, but the scramjet engine failed to function as intended.¹¹³ The failure of the test after the previous claimed success underscores the challenges DRDO has encountered in achieving hypersonic flight using scramjet technology and calls into question the credibility of the claims made following the September 2020 “breakthrough” test, in which most operations of HSTDV were claimed to have occurred in a “textbook manner.”¹¹⁴

In November 2024, DRDO conducted the flight trial of a “long-range hypersonic missile” with a range above 1,500 km.¹¹⁵ The official press statement did not specify the missile type, but the officially released video of the test showed a conical-shaped missile body with significantly huge fins mounted on a rocket booster. The press statement mentioned that the missile carried out “successful terminal maneuvers.” If successfully achieved, terminal maneuverability is a significant feat and can be instrumental in evading point

[sidebar-nav-2](#); “April 28, 2001: The First Captive-Carry Flight NASA’s X-43A Hypersonic Research Vehicle,” Air Force Testing Center, last modified April 28, 2021, <https://www.aftc.af.mil/News/On-This-Day-in-Test-History/Article-Display-Test-History/Article/2554297/april-28-2001-the-first-captive-carry-flight-nasas-x-43a-hypersonic-research-ve/>.

¹¹¹ James Acton (Co-Director, Nuclear Policy Program at Carnegie Endowment for International Peace), in discussion with the author, October 22, 2025. For a detailed discussion on challenges to hypersonic flight, see Kevin Dirscherl, Michael Riechers, and Jonathan Sanders, “Hypersonic Speed Through Scramjet Technology,” University of Colorado, December 17, 2015, https://www.colorado.edu/faculty/kantha/sites/default/files/attached-files/67552-116619_-_michael_riechers_-_dec_17_2015_1225_pm_-_dirscherl_riechers_sanders_final.pdf.

¹¹² See Kajal, “India Test-Flies...”

¹¹³ Rajat Pandit, “India Conducts another Test in a Bid to Develop Hypersonic Weapons,” *Times of India*, January 28, 2023, <https://timesofindia.indiatimes.com/india/india-conducts-another-test-in-a-bid-to-develop-hypersonic-weapons/articleshow/97389386.cms>.

¹¹⁴ “DRDO Successfully Flight Tests.”

¹¹⁵ Government of India, “DRDO Carries out Successful Flight-Trial of India’s First Long-Range Hypersonic Missile off the Odisha Coast,” Government of India, Press Information Bureau, November 17, 2024, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2073994>.

air defenses and engaging targets with high precision. However, no details are publicly available regarding the degree of terminal maneuverability the RV achieved. A high degree of terminal maneuverability—which is technically challenging—could indicate that the missile is closer to MaRVs. In contrast, limited terminal maneuverability could indicate a closer resemblance to guided ballistic missiles.¹¹⁶ MaRVs, however, make a slightly early re-entry into the atmosphere and briefly glide before diving at the target (Figure 1). The statement following the test does not mention the glide phase, suggesting that maneuverability may be limited to the terminal phase. In June 2025, the DRDO Chief Samir Kamat claimed that India’s “Hypersonic Glide Missile” is in an “advanced stage,” and that one successful development trial has been conducted.¹¹⁷ Most likely, Kamat was referring to the November 2024 test, which suggests that DRDO categorizes the missile as a BGV and that it might have a glide phase and considerable terminal maneuverability.

The November 2024 test press statement claimed that the system is highly accurate and capable of carrying different types of payloads for “armed forces”, which suggests it could be used in a conventional precision strike role by the three services of the Indian military. Most importantly, the range of around 1,500 km suggests that the missile is suited for operations against Pakistan. India’s Defense Minister Rajnath Singh termed the test a “historic moment” and “a significant milestone, which made India part of the group of selected nations to have such critical and advanced technology.”¹¹⁸ Keeping in view India’s struggle with scramjet-powered hypersonic flight and limited details about the sole test of the terminally maneuverable missile, the Defense Minister might

¹¹⁶ According to James Acton, BGVs, MaRVs, guided ballistic missiles, and normal ballistic missiles are part of a single missile spectrum. The spectrum spans highly maneuverable BGVs at one end and traditional ballistic missiles at the other. Though no standard exists, these missiles can be roughly distinguished based on the degree of maneuverability and the duration of the glide phase.

¹¹⁷ Shiv Aroor, “India’s Hypersonic Missile is in Advanced Stage: DRDO Chief to NDTV,” NDTV, June 19, 2025, <https://www.ndtv.com/india-news/indias-hypersonic-glide-missile-is-in-advanced-state-drdo-chief-samir-v-kamat-to-ndtv-8711132>.

¹¹⁸ Rajnath, “India has achieved a major milestone...”

have jumped the gun in declaring India as part of the hypersonic club.¹¹⁹ The hurriedness underscores the overriding role of prestige driving most of India's weapon developments, particularly in the nuclear domain.¹²⁰ In February 2025, pictures of a "Hypersonic Glide Missile" surfaced on social media, reportedly from a defense exhibition in India's Hyderabad.¹²¹ The missile with significantly large fins was claimed to be a Long-Range Anti-Ship Missile (LR-AShM) and was apparently medium-range. A comparison of images of the missile from the November 2024 test and the exhibition suggests some resemblances, as both have massive fins. Still, the shapes and designs of the two vehicles do not precisely match. This indicates that LR-AShM may not be the missile tested in November 2024 and may instead be another project being pursued by DRDO.

In January and April 2025, India claimed to have conducted ground testing of an "active cooled" scramjet combustor, with durations of 120 seconds and 1,000 seconds, respectively.¹²² The tests reflect India's consistent focus and investments in complex scramjet technology. However, given the colossal complications involved in scramjet operation and scramjet-powered hypersonic flight, it could be well over a decade before India achieves the technological maturity to achieve scramjet-powered hypersonic flight, adequate for an operational weapon system. Possibly because of the complications involved in scramjet-powered hypersonic flight, India now appears to be making a parallel

¹¹⁹ The complexity of hypersonic flights (cruise & boost-glided) means that multiple tests are required to validate the design parameters and operational performances of various aspects of the flights. Only one test cannot be considered adequate to accurately evaluate all these critical aspects.

¹²⁰ India has long considered its nuclear weapons capability a token to achieve a high status at the global level. See, George Perkovich, *India's Nuclear Bomb: The Impact on Global Proliferation* (London: University of California Press, 1999), pp. 400, 440. The statements by Indian leadership following major weapon or missile tests also underscore the prestige dimension. See, Jeffrey Gettleman and Hari Kumar, "India Shot Down a Satellite, Modi Says, Shifting Balance of Power in Asia," *The New York Times*, March 27, 2019, <https://www.nytimes.com/2019/03/27/world/asia/india-weather-satellite-missile.html>.

¹²¹ News IADN (@NewsIADN), "First Visual of DRDO Hypersonic Glide Vehicle...", X, February 28, 2025, <https://x.com/NewsIADN/status/1895346256005996635>.

¹²² Government of India, "DRDO Achieves Significant Milestone in Scramjet Engine Development," *Government of India, Press Information Bureau*, April 25, 2025, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2124415>.

focus on HBGVs or MaRVs, as reflected by the November 2024 test. Kamat stated during the NDTV interview that, upon completion of development trials over the next two to three years, the missile would be inducted. Given that BGVs and MaRVs involve relatively fewer technological complications and that India's relentless pursuit of hypersonic weapons is underway, India's BGV or MaRV program is likely to make relatively faster headway. It might be ready for operational deployment in the next few years. This means that until the development of HCMs, BGVs (or MaRVs) would likely be the mainstay of India's hypersonic arsenal.

India's Hypersonic Weapons and Strategic Stability in South Asia

Given that India is already pursuing a significant buildup of precision-strike and counterforce capabilities, hypersonic weapons are likely to catalyze existing trends in India's strategic buildup, with profound implications for strategic stability in South Asia. However, given that Pakistan has been pursuing prudent weapon developments to offset the destabilizing impact of India's strategic build-up and has vowed to press ahead on this trajectory, hypersonic weapons are unlikely to be a game-changing technology that upends the strategic equilibrium in South Asia.¹²³

Hypersonic Weapons and India's Doctrinal Posture

The deployment of hypersonic weapons is likely to intensify India's doctrinal tilt towards precision strikes and counterforce targeting. This could incentivize India to act more aggressively, especially during a crisis. Considering that Pakistan has not fielded a BMD system and India already flaunts a wide range

¹²³ Speaking at the first Islamabad Non-Proliferation Conference (INC-2026), Advisor to Pakistan's NCA, Lt. Gen. Kidwai (R), underscored that Pakistan's policy planners are cognizant of India's capabilities build-up and stated Pakistan will undertake "minimum" measures in response to evolving threats. "Special Session: Lt Gen Khalid Ahmed Kidwai, NI, HI, HI (M), (Retd), (INC-2024), Day 02, 9th Oct 2024", Strategic Vision Institute, October 22, 2024, *YouTube Video*, 44:28-46-05, <https://www.youtube.com/watch?v=gizvlbSeqc>.

of conventional and nuclear missiles suitable for precision strikes and counterforce missions, some analysts have described India's use of hypersonic weapons against Pakistan as "superfluous."¹²⁴ However, once India has hypersonic weapons in its arsenal, it would be imprudent for Pakistan to count on the assumption that India will be self-restrained from employing these weapons. In fact, the recent four-day conflict underscored that cutting-edge weapons—such as the hypersonic missiles—might be used first to maximize damage at the outset. The evolving trends suggest that hypersonic weapons are likely to instill more aggression in India's doctrinal posture.

Hypersonic Weapons and Pakistan-India Limited Military Conflicts

Over the past six years, Pakistan and India have twice engaged in limited military conflicts. The conflict patterns suggest that each sets the baseline for the next, and with each iteration, not only is the geographical scope of hostilities widening, but several weapons that were previously considered prohibitively escalatory are being used.¹²⁵ Moreover, owing to the integration of modern systems on both sides, the tempo of military operations and the scope of hostilities have significantly increased, reducing the window for third parties to mediate de-escalation. Most importantly, the two sides have apparently learnt totally contrasting lessons from the conflict. On the one side, Pakistan has warned multiple times about the escalatory risks associated with hostilities between the two nuclear-armed states.¹²⁶ On the other hand, India, under the

¹²⁴ Ali Mustafa, "Speed Without Substance? India's Hypersonic Missile and Implications for Strategic Stability," *South Asian Voices*, January 11, 2025, <https://southasianvoices.org/sec-m-pk-r-india-hypersonic-missiles-1-11-2025/>.

¹²⁵ Christopher Clary, "Four Days in May: The India-Pakistan Crisis of 2025," Stimson Center Working Paper, May 28, 2025, <https://www.stimson.org/2025/four-days-in-may-the-india-pakistan-crisis-of-2025/>.

¹²⁶ For Pakistan's repeated warnings about the risks associated with a war between two nuclear-armed states, see "In reality, there is no space for war between India and Pakistan: DG ISPR," *Dawn*, last modified May 11, 2025, <https://www.dawn.com/news/1910365>; "Indo-Pak war will be 'recipe for mutual destruction': DG ISPR, last modified May 16, 2025, <https://tribune.com.pk/story/2546109/indo-pak-war-will-be-recipe-for->

false sense of security and dangerous confidence, considers that the evolved dynamics have enabled it to break free from the strategic gridlock vis-à-vis Pakistan post-nuclearization and appears intent on pressing the perceived advantage by expanding the scope and scale of limited conventional operations.¹²⁷ During the recent Four-Day conflict, India made two costly underestimations: 1) the range of Pakistan's Chinese-made PL-15 missiles, 2) the accelerated effectiveness of Pakistan's kill chain.¹²⁸ Most importantly, India sought to operate beyond the perceived range of Pakistan's ground-based defenses and air-to-air missiles.¹²⁹ The combination of miscalculations and tactical errors led to the loss of several top-of-the-line jets, grounding the Indian Air Force (IAF) for at least two days.¹³⁰

Considering the experience of the four-day conflict, India may not be inclined to use air power without the degradation of Pakistan's air defense capability. It may be inclined to commence operations with DEAD attacks. Hypersonic weapons in a conventional role may be employed for DEAD missions and for targeting air bases and traditional missile storage sites. This means the onset of hostilities at a significantly higher escalatory rung, which could trigger a chain

[mutual-destruction-dg-ispr](#); "No space for war in nuclearized environment, COAS Munir cautions India," *Dawn*, October 18, 2025, <https://www.dawn.com/news/1949711>.

¹²⁷ Happymon Jacob, "Twelve Arguments to Make Sense of Op Sindoor," *Operation Sindoor and India's New Doctrine of Deterrence*, ed. Lt Gen D S Hooda (Retd) and Happymon Jacob (New Delhi: Center for Strategic and Defense Research, 2025), pp. 18-20.

¹²⁸ Akalia Kalan, "How Did Pakistan Shoot Down India's Fighter Jets," *The Economist*, July 16, 2025, <https://www.economist.com/asia/2025/07/16/how-did-pakistan-shoot-down-indias-fighter-jets>.

¹²⁹ India's Defense Attaché in Indonesia, Captain Shiv Kumar, blamed losses of Indian aircraft on the constraints imposed by political leadership not to attack Pakistan's air defense or military targets. Hence, the attack plan might have been to operate beyond the range of Pakistan's Surface-to-Air (SAM) missiles. However, the PAF spokesperson claimed that one Indian jet was shot down by Pakistani air defenses, which suggests that India might have even underestimated the reach of Pakistan's SAMs, too. See, Aaj News, "PAF provides evidence of shooting down Indian Rafales," Aaj News, last modified May 10, 2025, <https://english.aaj.tv/news/330415957/paf-provides-evidence-of-shooting-down-indian-rafales>. Also see, R.K. Radhakrishnan, "Defense Attaché in Indonesia Claims Loss of IAF Aircraft," *Frontline*, June 30, 2025, <https://frontline.thehindu.com/world-affairs/iaf-aircraft-loss-operation-sindoor-defence-attache-statement/article69755192.ece>.

¹³⁰ India's Chief of Defense Staff said that after initially losing aircraft, the IAF rectified its mistakes and flew after two days. See Haslinda Amin and Philip Heijmans, "India Confirms It Lost Fighter Jets in Recent Pakistan Conflict," *Bloomberg*, May 31, 2025, <https://www.bloomberg.com/news/articles/2025-05-31/india-confirms-it-lost-fighter-jets-in-recent-pakistan-conflict>.

of events that creates significant risks of “escalation through entanglement” and possibly sets off a gallop towards deterrence breakdown.¹³¹ The resulting possibility suggests that each limited crisis in South Asia involving India’s use of hypersonic missiles would likely entail a nuclear dimension, entailing the highest degree of crisis instability.

Hypersonic Weapons and India’s Counterforce Temptations

Hypersonic weapons in both conventional and nuclear roles have the potential to be used for counterforce attacks against land-based missiles and nuclear-delivery aircraft. The augmentation of India’s counterforce capabilities is likely to heighten the threat of a disarming first strike by Pakistan, compelling it to enhance the readiness of its arsenal. Given that most of India’s nuclear arsenal is already placed on a high state of alert, the consequence could mean increased first-strike instability in South Asia. Moreover, the potential of hypersonic weapons for static targeting of Transport Erector Launchers (TELs), which are considered key to survivability, is especially destabilizing and would deal a jolting blow to strategic stability in South Asia.¹³² India’s potential designation of nuclear as well as conventional roles for its hypersonic weapons is likely to create warhead and target ambiguity for Pakistan.¹³³ The dual-ambiguity problem could be especially aggravating during a crisis, with the fog of war further complicating decision-making. This would mean that each Pakistan-India crisis involving the use of hypersonic missiles by India could have a high risk of accidental escalation into a nuclear war, entailing the highest degree of crisis instability.¹³⁴

¹³¹ For the pioneering work on inadvertent escalation, see, Barry Posen, *Inadvertent Escalation: Conventional War and Nuclear Risk* (New York: Cornell University Press, 1991), PP. 1-3; Naeem Salik argues that even the conventional attacks on Pakistan’s nuclear facilities would be considered decapitating strikes and would be responded to accordingly. See, Salik, “Recalibrating Strategic Stability.” For the risk of escalation through entanglement, see Acton, “Escalation through Entanglement.”

¹³² Wilkening, “Hypersonic Weapons,” p. 136.

¹³³ Wilkening, “Hypersonic Weapons,” p. 131.

¹³⁴ For a detailed discussion on crisis instability, see Acton, “Reclaiming Strategic Stability,” pp. 120-123.

To offset the impact of India's counterforce build-up, Pakistan is compelled to undertake remedial arms developments under its FSD policy within the CMD precincts. The measures Pakistan may undertake to stabilize the deterrence equation may include adding delivery systems and warheads, relying more on decoys, and hardening its defenses.¹³⁵ Moreover, Pakistan would have more substantial incentives to MIRV its missiles to ensure the penetration of India's BMD and invest more in its assured sea-based second-strike capability. On the other hand, India—motivated by the desire to achieve strategic superiority over Pakistan—would have even stronger incentives to continue building its counterforce capabilities, aggravating arms race instability in South Asia.¹³⁶

Conclusion

Considering that the above-mentioned factors imperil precarious strategic stability in South Asia and entail grave risks of deterrence breakdown, the ideal situation for Pakistan and India would be to enter into dialogue focused on stabilizing the regional strategic equation through risk-reduction mechanisms or restraints on arms build-up. However, India, under PM Modi, has displayed no interest in any dialogue with Pakistan and continues an aggressive build-up of conventional and nuclear capabilities. This means that not only are the probabilities of achieving strategic stability in South Asia through the dialogue minimal, but India's military build-up would likely continue unabated, thereby unremittingly straining the strategic equilibrium in the region. India's acquisition of conventional and nuclear capabilities for counterforce strikes is particularly destabilizing, as it entails serious risks of the breakdown of deterrence. Peter Feaver argues that disarming first strikes are "very difficult

¹³⁵ For a discussion on survivability, see Keir A. Lieber and Daryl G. Press, *The Myth of Nuclear Revolution: Power Politics in the Atomic Age* (Ithaca and London: Cornell University Press, 2020), pp. 67-70.

¹³⁶ Christopher Clary and Vipin Narang have described this phenomenon as "counterforce feedback loop." See, Clary and Narang, "India's Counterforce Temptations," pp. 38-46.

and thus very unlikely”, but he stops short of ruling them out as a practical option.¹³⁷

Therefore, irrespective of whether India would ever be able to achieve nuclear superiority over Pakistan or would ever feel confident about its capability to launch counterforce strikes, complacency cannot be an option. Islamabad must continue to take remedial measures to maintain the credibility of its deterrence and minimize the fear of a disarming first strike. Among other options to enhance the survivability of its arsenal, an assured sea-based second-strike capability would be Islamabad’s trump card to instill in New Delhi the belief that a disarming first strike would not avert the infliction of unacceptable damage to India.¹³⁸ Moreover, it must also focus on accumulating more firepower in individual delivery vectors to ensure that doctrinally desired unacceptable damage is inflicted on India, even if a smaller number of nuclear weapons reach their targets. However, keeping in view the growing vulnerability of nuclear submarines owing to technological breakthroughs, and in view of the fact that Pakistan does not have nuclear-powered submarines armed with SLBMs, the country may focus on building a survivability mix of land, air, and sea-based nuclear forces to complicate India’s counterforce calculus and thus deter any Indian adventurism.¹³⁹

¹³⁷ Peter D. Feaver, Scott D. Sagan and David J. Karl, “Correspondence: Proliferation Pessimism and Emerging Nuclear Powers,” *International Security*, Vol. 22, No. 2 (Fall 1997), p. 188, <https://doi.org/10.2307/2539374>.

¹³⁸ Schelling, *The Strategy of Conflict*, 237.

¹³⁹ For discussions on the increasing vulnerability of submarines, see, Tom A. Stefanick, “Undersea Nuclear Forces: Survivability of Chinese, Russian, and US SSBNs,” *Journal of Strategic Studies*, Vol. 48, No. 2 (2025), pp. 407-464, <https://doi.org/10.1080/01402390.2025.2454644>; Lieber and Press, “The Myth of Nuclear Revolution,” pp. 82-84; Steve Fetter & Jaganath Sankaran, “Emerging Technologies and Challenges to Nuclear Stability,” *Journal of Strategic Studies*, Vol. 48, No. 2, pp. 252-296, <https://doi.org/10.1080/01402390.2024.2433766>.