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RESEARCH ARTICLE

Technological Determinism and Strategic Stability: Implications of Indian Hypersonic Weapons Technology for Pakistan

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Abstract: This research posits that Indian development of hypersonic weapons is likely to undermine the strategic stability of South Asia because hypersonic weapons would incentivize India to contemplate counterforce options against Pakistan. Using a combine of technological determinism and strategic stability theories, this study explores the Indian hypersonic technology based weapon systems and how they might denunciate strategic stability dynamics in South Asia. The study explains implications of Indian hypersonic weapons on Pakistan's deterrence stability. The study finds that technological determinism caused by hypersonic weapons would compel India to harbor preemptive counterforce strike ambitions against Pakistan's nuclear forces. Also, in a crisis situation Indian decision makers are likely to be emboldened by possession of hypersonic weapons technology and take escalatory steps instead of crisis mitigation. In response Pakistan should enhance its second strike capability by increasing number of nuclear capable submarines and by increasing the range of Submarine Launched Ballistic Missile. Pakistan needs to work on dispersion and camouflage/concealment of her nuclear assets; and develop her own hypersonic technology in collaboration with China. These measures by Pakistan would help maintain strategic stability in South Asia.

Keywords: Indian Hypersonic Weapons, Counterforce Incentives, Pakistan's Second Strike Capability, Strategic Stability Challenges, Escalatory Crises, Confidence and Trust Building

Introduction

The arrival of hypersonic weapons has introduced major problems for strategic stability as they increase the chances of offensive action by mitigating the significance of defence.(Hypersonic weapons are the most useful weapons for first strike because they can penetrate the defensive systems of the adversary state and can hit targets suddenly with great accuracy and lethality. Inability of the threatened state to accurately determine where the hypersonic missile might hit, is likely to cause difficulties for strategic stability (Lee, 2022). South Asia's strategic stability is already challenged by the volatile relationship between nuclear armed Pakistan and India. The relations between the two have been problematic since their independence, and their mutual rivalry is often exacerbated by political and territorial conflicts. The tense situation between Pakistan and India is being intensified by Indian technological developments and aggressive military doctrines (Naz, 2023). Emerging technologies, especially the hypersonic weapons, are challenging South Asian strategic stability as they are transforming warfare due to their speed, agility and efficacy (Noor, 2023).

Hypersonic missiles are symbols of prestige for the states and present substantial tactical benefits like "reduced reaction times and increased survivability, while also presenting strategic challenges to conventional missile defense systems, potentially destabilizing the global security landscape. (Hypersonic Weapons: Background and Issues for Congress, 2021). A simple definition of hypersonic vehicle is "a device that can fly faster than Mach 5." As speed of sound is 750 miles per hour (mph), five times faster than the speed of sound would mean 3750 mph (Hypersonic Missiles: What Are They and Can They Be Stopped? , 2019). Hypersonic missiles like the Russian Oreshnik and Avangard travel at Mach 11 and Mach 20+

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respectively. Hypersonic weapons pose challenges to missile defense systems due to their maneuverability during their flight trajectory, which induces unpredictability in their flight path. So, defense against hypersonic missiles becomes rather difficult due to their speed, agility and unpredictable flight trajectory. Hypersonic missiles with conventional non-nuclear warheads can be used against high value targets such as aircraft carriers, infrastructure targets and nuclear installations. However, hypersonic missiles are expensive and may not be developed in large quantities (Boyd, 2023). Hypersonic technologies have existed for more than 60 years but recently these technologies have been considered very important due to the tremendous interest and attention of the great powers due to their role in the strategic competition (David, 2021). At the same time, debates about hypersonic missiles "revolve around acquiring hypersonic missiles and pursuing arms control initiatives and there is academic consensus that hypersonic weapons technology has implications for strategic stability (Lee, 2022)."

India has cooperated with Russia for the production of BrahMos II, a Mach 7 hypersonic cruise missile. Although BrahMos II was originally planned to be launched in 2017, research identifies that the program confronts significant delays and is now scheduled to achieve its functioning capability approximately till 2028. India is building a local, twin capable hypersonic cruise missile as part of its Hypersonic Technology Demonstrator Vehicle (HSTDV) program and has demonstrated a Mach 6 scramjet in 2019 and 2020 respectively. There are twelve hypersonic wind tunnels working in India. They are proficient in testing hypersonic missiles with speeds higher than Mach 13 (Hypersonic Weapons: Background and Issues for Congress, 2021).

India tested its HSTDV in 2023 by enhancing its hypersonic capabilities but has not released any information about its success. The target of this test was to achieve the flight in 600 seconds by covering the distance of 1500 km while carrying warhead of 300 to 400 kg. Indian official media sources have declared this test to be a successful one (Saxena, 2023). India has established its first Hypervelocity Expansion Tunnel Test facility in 2024, which would further enhance Indian hypersonic capabilities. "The facility, named S2, is capable of generating flight speeds between 3-10 km/s, pretending the hypersonic conditions encountered during atmospheric entry of vehicles, asteroid entry, scramjet flights, and ballistic missiles (IIT Kanpur achieves major milestone with India's First Hypervelocity Expansion Tunnel Test Facility, 2024)." The facility is located at Indian Institute of Technology Kanpur Hypersonic Experimental Aerodynamics Laboratory (HEAL) (IIT Kanpur achieves major milestone with India's First Hypervelocity Expansion Tunnel Test Facility, 2024). Hypersonic missiles can hardly be detected, but the latest developments in technology are working to develop countermeasures for them (Hypersonic Missiles: What Are They and Can They Be Stopped , 2019).

The core research question that this paper explores is whether Indian acquisition of hypersonic technology undermines the strategic stability of South Asia and how Pakistan could respond to the implications of Indian hypersonic weapons technology. It is hoped that the findings of this research would serve as genuine inputs to the defence and security policy circles in Pakistan. The research is also intended to contribute to academic debate on the issues of hypersonic weapons technology and its effects on strategic stability of South Asia.

Scanning the Literature

Ayesha Abbasi argues in her article Indian Quest for Hypersonic Missiles in South Asia and Disruption of Strategic Stability in the Indo-Pak Dyad that India is pursuing hypersonic weapon for prestige, but it would be perceived as a security threat by Pakistan. Hence, Pakistan needs to follow the option of full spectrum deterrence by investing more in defensive technology to fulfill the requirement of security and to ensure credible deterrence. The article highlights that use of hypersonic technology would enhance Indian deterrence stability, but it would pose risks to Pakistan's security. The ensuing arms race for the acquisition of hypersonic weapon technology among states would destabilize strategic stability on regional level (Abbassi, 2023).

Stephen Reny explains in his article Nuclear-Armed Hypersonic Weapons and Nuclear Deterrence that hypersonic competition would penetrate defence by increasing instability in the region. Indian acquisition of

hypersonic technology, cruise and boost glide vehicles would bring instability by incentivizing India for counterforce strike that could destroy much of Pakistan's nuclear forces (Reny, 2020). Hence Pakistan needs to bolster submarine-launched ballistic missiles (SLBMs) and solid fuel rockets to create better deterrence stability; and needs to produce hypersonic boost/glide or cruise missile to counter India.

Ghazala Yasmin Jalil highlights in her article Missile Race in South Asia that competition of missiles between Pakistan and India poses risk to the strategic stability of South Asia. Indian development of missile compels Pakistan to improve its defence and security capability. According to Ghazala Yasmin, Indian development of hypersonic missile Brahmous II is eroding the integrity of nuclear weapons. She concludes that Pakistan needs to achieve balance between its security requirements and arms race because arms race is not beneficial for its economy (Jalil, 2020).

Sitara Noor in her article Strategic Stability in South Asia: The Evolving Challenges and Potential Opportunities for India and Pakistan observes that the spiraling competition between America and China, and Indo-China border disputes are exacerbating regional security dynamics. But it is the entrenched hostility between India and Pakistan that increases the risk of war. At the same time, emerging technologies like hypersonic weapons are influencing the balance of terror between India and Pakistan. Under these circumstances, both states should develop mutual trust and confidence to enhance regional strategic stability (Noor, 2023).

Rabia Akhtar in her seminal policy brief tiled Technological Determinism and Challenges to Deterrence in Southern Asia opines that strategic stability in South Asia is frail as there are many challenges to it. Technological developments like hypersonic weapons are imparting new capabilities to India to undermine Pakistan's deterrence by counterforce employment. Under these circumstances, Pakistan and India need to have dialogue on strengthening strategic stability in South Asia (Akthar, 2022).

The foregoing literature scan depicts an abiding interest of the academics in the development of hypersonic weapons technology by India and how it is likely to upset South Asian strategic stability. However, except for Dr Rabia's policy brief, hardly any literature piece has used the lens of technological determinism to examine the implications of hypersonic weapons technology. This paper attempts to fill this gap by using the combination of technological determinism and strategic stability perspectives to carry out a systematic exploration of how Indian hypersonic weapons are likely to destabilize South Asian strategic stability.

Theoretical Framework

This research uses a combination of theories of Technological Determinism and Strategic Stability to answer its basic research question. According to the main proponent of technological determinism Thorstein Veblen, technology transforms society and it has implications for social life. Technology has command to guide the whole mechanical world while efficacy of everything including weapons is increasing due to the persistent development of technology Technological determinism claims that technology is an autonomous force that transforms the world and influences the interaction of states with one another (Hauer, 2017). Its assumptions explain that states are determined to integrate technologies to gain dominance over their adversaries because technology is an independent force that has implications for power and security (Akhtar, 2022).

Theory of strategic stability can be explained in three main points. Firstly, it is about the absenteeism of incentives to use nuclear weapons first. Secondly, nonexistence of incentives to modernize the nuclear force; and thirdly, the absence of military option in resolution of disputes and dependence of diplomacy and dialogue between nuclear-weapon states (Acton, 2013). Theory of Strategic Stability is about the nonexistence of incentives for a nuclear state to use nuclear weapons first (Trenin, 2019). Thomas Schelling explains that if both states have nuclear weapons, they do not need to use nuclear weapons first due to the fear of their own destruction. In condition of strategic stability, the promise of mutual vulnerability would deter a state to launch nuclear weapons first against its enemy. In a broader view strategic stability means a stable situation and nonexistence of conflict where states are enjoying peaceful relations (Noor, 2023).

Combined theoretical perspectives of technological determinism and strategic stability posits that India is determined to advance its military prowess by developing hypersonic weapons. And development of hypersonic weapons is undermining strategic stability as hypersonic weapons are increasing Indian potential to launch counterforce strike against Pakistan. It is also forcing Pakistan in acquiring hypersonic weapons technology to balance Indian capability. As states are integrating technologies to gain dominance and superiority over their adversaries, integration of hypersonic weapons technology by India has serious implications for Pakistan. Indian hypersonic weapons technology is undermining South Asian strategic stability as it imparts India with counterforce capability against Pakistan and leads to arms race. Hence, Indian technological determinism seen in her counterforce ambition and her quest for emerging advanced technologies is making the strategic stability of South Asia fragile (Akhtar, 2022).

Research Methods

This research uses exploratory design and qualitative research methods. Scores of articles, some good books and many You Tube videos on hypersonic weapons technology are available and provide good resource on hypersonic weapons technology and its role in warfare. This research uses primary sources like policy briefs, official reports, archives and expert interviews. Secondary sources like journal articles, books and book chapters, newspapers and internet sources have also been used to gather data.

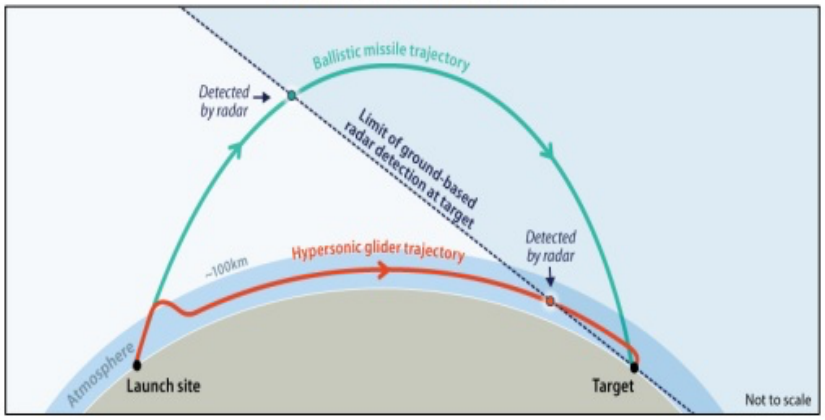
Hypersonic Cruise Missiles and Hypersonic Glide Vehicles

Hypersonic Cruise Missiles (HCMs) are "hypersonic weapons that carry fuel and engines to power them for much of their flight through the atmosphere at low altitudes (Hypersonic technology demonstrator vehicle, 2019)." They use scramjet (supersonic combustion ramjet) engines which are air breathing engines. These engines take air and oxygen from the air and blend it with the hydrogen vigor to produce combustion for generating force that takes them to speeds in excess of Mach 5 and permits them to maneuver throughout the trajectory. According to the Indian experts Hypersonic cruise missiles are considered to be game changers in battle and that they give a nation a winning edge. This claim has been supported by the Russian employment of Kinzhal and Zircon hypersonic cruise missiles against Ukraine in the on-going war (Shankar, 2024).

Hypersonic Glide Vehicles (HGVs) are carried by a ballistic missile to speeds of up to Mach 20+. The HGV separates from its missile during the climb phase and is inserted into the upper atmosphere at about 50 km. It then proceeds to its target following an unpredictable path. The speed, maneuverability and low-altitude flight make hypersonic glide vehicles very attractive weapons to elude missile defences ("Hypersonic technology demonstrator vehicle, 2019). HGV is different from ballistic glide because it works in upper atmosphere by using force of aerodynamic. It can carry nuclear and conventional payloads (Jilani 2024).

Figure

Terrestrial-based Detection of Ballistic Missiles vs. Hypersonic Glide Vehicles



Source: Hypersonic Weapons: Background and Issues for Congress," Congressional Research Service (CRS), October 19, 2021.

Indian Hypersonic Aspirations

India wants to achieve hegemonic status in the region hence it is modernizing its military day by day. It is investing billions of dollars on emerging technologies to raise its status in the region. The recent test of India indigenously hypersonic technology makes it world fourth state with this technology. India is building Cruise missiles BrahMos II which will have speed more than Mach-five and assessed range of 450-600 km. India has developed hypersonic technology for prestige and to fulfill its military objectives in the region. Hypersonic weapons give technological advantage to India and put great pressure on Pakistan (Samran Ali, Personal communication, July 2024).

India tested Shaurya missile in 2020. It is a canister-launched, hypersonic surface-to-surface ballistic missile developed by India's Defence Research and Development Organisation (DRDO), capable of reaching speeds of 7.5 Mach and a range of 750 kilometers (Singh, 2020). Indian development of these hypersonic technology gives feed to its counterforce strike because Indian Shourya HSW (750km) can target Pakistan's all nuclear forces. BrahMos is also poised against Pakistan for counterforce while India distracts the world by showing that its investment in technologies is due to Chinese threat. Indian development of hypersonic technology would erode the nuclear stability or deterrence equilibrium between Pakistan and India. HSWs would give false sense of confidence to India to launch first strike against Pakistan through hypersonic technology. Besides this, geographical proximity between India and Pakistan greatly reduces the flight time due to super speed of hypersonic missiles. This makes the situation rather dangerous for Pakistan; as it would not be able to identify, track and defend against Indian hypersonic missiles due to their hyper speed and continuous maneuverability during flight (Abbasi, 2023). Indian hypersonic Shaurya is very effective against radars, military installations such as command and control centers and air basis (Pant and Bommakanti, 2022).

India could use hypersonic missiles in three possible scenarios as it can launch limited air strike against Pakistan. Because the usage of hypersonic weapons would reduce the requirement of Indian manned aircraft Secondly, India could use hypersonic weapons to launch counterforce strikes as it would thwart Pakistan from the timely deployment of its tactical nuclear weapons. Hypersonic weapons have potential to target the mobile ground based nuclear forces with more accuracy and they cannot be intercepted due to hypersonic fast speed. They reach the target within few minutes and leave no option for the enemy (Sultan and Khursheed, 2021).

Capabilities of Indian Hypersonic Technology

Indian integration of hypersonic technology and ballistic missile technology can lead to nuclear escalation between Pakistan and India. Hypersonic Weapons are capable to hit their targets quickly in 15 to 30 minutes from 1000 of km away. Hypersonic weapons are expensive and better than the ballistic missiles because they can be operated outside the atmosphere and they are better in penetrating the long range missile defences. Hypersonic weapons have potential to create uncertainty about their ultimate target, and their low flight capability puts them below the horizon for long range radar and makes them difficult to track. They have ability to maneuver during flight and making their path unpredictable. Ballistic missile equipped with MaRV (Maneuverable Reentry Vehicle) also create uncertainty about their target by maneuvering during the last stages of their trajectory or flight. Due to speed and maneuverability, it is difficult for adversary to guard against hypersonic attack. With the successful test of hypersonic missiles, India has come closer in maturing this technology that only powerful nations possess. Hypersonic Technology increases Indian capability to conduct a first strike against road mobile missiles of Pakistan, sensitive targets like command and control centers, air bases, surfaced submarines- all this would diminish the impact of Pakistan's retaliatory strike (Ali, 2020).

Implications for Pakistan

Hypersonic missiles are faster weapons that maneuver during flight and it is hard to destroy them through air defence systems. India has large economy and depends more on indigenous technological development. Hence it is increasing more asymmetry between both states by posing challenges to deterrence in the region (Christopher Clary, personal communication, July 2023). India's emerging drone and hypersonic missile capabilities will make Pakistan more vulnerable to air and missile attack (Kazmi, 2024). Pakistan perceives existential threat from Indian offensive and unrestrained hypersonic weapons technology because it increases Pakistan's insecurity and destabilizes regional strategic stability. The emerging geostrategic realities in the region like competition between the US and China, and China and India, has made the original strategic environment overly complex. The global and regional dynamics and triangular relationship US and India to counter China has a direct impact on the regional environment. The Indo-US strategic partnership and Indian offensive power posture undermines regional stability and compels Pakistan to develop its own technologies. (Abassi and Khan, 2019). Ballistic missiles take 5-10 minutes between Pakistan and India, while hypersonic technology reduces the time to seconds (Mehmood, 2023). Indian acquisition of hypersonic weapons, ballistic missile, nuclear capable submarines and India's enhanced intelligence, surveillance, and reconnaissance (ISR) capabilities has tilted the strategic balance in the favour of India. Pakistan's main fear is Indian capacity and ambition for first strike against its strategic assets. This may force Pakistan to preemptively launch its nuclear weapons based on "use them or lose them" dilemma. Since it is not possible to identify whether a hypersonic missile is carrying conventional or nuclear warhead, this ambiguity can lead to a nuclear war between the two states. India wants to become the expert in technologies and missile program, and it is struggling for them even before the building of nuclear weapons in South Asia. India was not only the major state that tested nuclear weapons first but also the first state that obtained warhead technology in the region. There are multiple actual and operative delivery systems of India such has dual aircraft and nuclear submarine that complete its strategic triad. India has not indigenously acquired all technology, but it has largely benefited from Russia, France, Israel, Canada and US technologies (Abbasi and Khan, 2019). India is largest state of South Asia with the population of 1.3 billion and GDP of 2.6 trillion and interested to become global power, its attitude towards Pakistan is hegemonic. Indian integration of latest hypersonic technology will force Pakistan to react and enter into a costly arms race (Bashir, 2021).

India has accentuated security risks for Pakistan by joining the hypersonic club. India is planning to develop more advanced hypersonic technology in the next five years, which will increase Pakistan's security dilemma even more. Under Prime Minister Narendra Modi's government India's hawkish policies are clearly indicating that it wants to become a regional dictator (Khan & Khan, 2020) and this is clearly due to technological determinism For instance, Indian Defence Minister Rajnath Singh announced on 15, December 2021 that development of hypersonic cruise missiles is necessary to maintain the credible deterrence against our enemies. India should become the leader in technology and should make efforts to indigenize those expertise and latest technologies that are with only have great powers. In fact, India wants to achieve hegemonic status based on her supremacy in disruptive technologies. (Kaushik, 2021).

Pakistan's Response to Indian Hypersonic Weapons Technology

India's emerging drone and hypersonic missile capabilities will make Pakistan more vulnerable to air and missile attack. Pakistan will have no alternative but to try and develop its own advanced capabilities in these areas to offset Indian capabilities symmetrically (one for one), or asymmetrically (finding niches that India has not developed) (Foster, personal communication, November 2023). The acquisition of Indian counterforce capability compels Pakistan to take counter measures to preserve the reliability of its deterrence posture. Firstly, Indian capability in hypersonic weapons forces Pakistan to putting its missiles on a high alert to reduce security dilemma. Secondly, Pakistan can great initiate production of indigenous production of hypersonic weapons to respond to India. If India chooses to launch counter force strike with its hypersonic weapons, then it can start a new competition between the two nuclear powers. India can miscalculate and

launch counterforce strike against Pakistan by supposing that Pakistan would not react with its nuclear forces. If Pakistan decides not to use nuclear weapons in response to a conventional hypersonic strike to avoid crossing the nuclear threshold, it can use cruise missiles which are proficient in penetrating the Indian missile defences and reach their targets with greater precision. Pakistan can use its Babur III (450 km) Supersonic Cruise Missile developed by Pakistan Navy, as it has the capability to target moving warships (Sultan and Khursheed, 2021). Babar III is not able to target Indian mainland, Pakistan needs to increase the range of submarine-launched ballistic missile (SLBMs) and submarine-launched cruise missile (SLCMs) to hit the main cities of India (Abbasi, 2023). Additionally, Pakistan's full spectrum deterrence posture introduced in 2011 to deter all types of threats from limited military encounters to all-out war- must be re-enforced (Sultan and Khursheed, 2021). While Lt Gen Khalid Ahmed Kidwai's statements on December 10, 2021, indicates that Pakistan would not let India create instability in the region, and would response forcefully to any irresponsible military action by India.

Pakistan should work for development of second strike capability because development of submarines would reduce the possibility of Indian preemptive strike by using hypersonic weapons. Although India has rejected numerous confidences building measures offered by Pakistan, yet Pakistan should continue to push for diplomatic engagement and confidence building measures to thwart the chances of unintentional escalation and miscalculation. The incident of misfiring of BrahMos missile can become the basis for Pakistan to build its case for diplomatic engagement (Abbasi, 2023).

Conclusion

Pakistan's nuclear policy seeks to strengthen strategic stability based of the principle of equal vulnerability, while India is trying to become a regional hypersonic weapons technology hegemon. The US is supporting India on multiple international platforms because it wishes to counter China in Asia Pacific through India. However, India's technologically deterministic attitudes of hegemony and offensive ambitions towards Pakistan are creating strategic instability in the region leading to arms race and unintended escalation during crises. This can lead a nuclear war between two states. Emerging hypersonic weapons technology is increasing the challenges of deterrence and strategic stability in the region. India is investing billions of dollars in modern technologies that is increasing security dilemma of Pakistan. Pakistan should also go ahead in research and development and take assistance from China for development and induction of these technologies. At the same time India and Pakistan need to build mutual trust and confidence to strengthen strategic stability in the age of hypersonic weapons technology by opening better channels of communication; share information about nuclear developments and carry out political and security dialogue with one another.

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