

Hypersonic Glide Vehicles:
Implications for Strategic Stability in the Coming Hypersonic Era

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Abstract

Hypersonic glide vehicles represent one of the first major strategic weapons developments since the end of the Cold War. These missiles, which are capable of carrying both nuclear and non-nuclear payloads threaten to alter the strategic balance of terror that has kept that great powers at peace since the late 1940's. Whether nuclear or non-nuclear these strategic weapons systems were developed in a strategic environment by the Russians and Chinese to bring increasing parity to their relationship with the United States. Their maneuverability, speed, and altitude make them impervious to ballistic missile defences now and into the near future, ensuring the continued survival of an assured destruction capacity for the three great powers. A stable strategic balance has served as the foundation for peace between the great powers since the advent of mass nuclear weapons; hypersonic glide vehicles foster a stable strategic balance now and into the near future, and as such it should be no surprise that these weapons will most likely be neither controlled nor abandoned by the three great powers. Instead, it is likely these missiles will serve as the new basis for mutually assured destruction and the corresponding strategic stability between the great powers into the coming decades.

Acknowledgements

Beautiful words, and poetic speech has never been my forte. Yet, standing on the precipice of my Master's Degree I am reminded that what I have achieved with this thesis is not a testament to me, but rather a testament to my loved ones, friends, and colleagues, without whom this work would have been impossible to bear.

First, to my Mother and Father, I am grateful to both of you. Your diligence, care, and love provided me the tools I needed to pursue my education. I left as the prodigal son, and may yet return to you as him, but at least I am a little farther from that than I was two years ago when this chapter began. Looking back, it has been quick and yet the story is left unfinished.....let us see what the future holds.

To my comrades and brothers in arms on this journey, Eric and Taras- thanks boys, you kept me moving forward, and I am eternally grateful for your assistance- should either of you light the beacons I will come to your aid as you came to mine.

And finally, to my supervisor, Dr. Elinor Sloan, thank you for your diligence as my supervisor; your work helped me complete this thesis and successfully defend it. I would have been lost many times without your guidance, so thank you.

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Introduction

Technology and strategic deterrence have co-evolved since the detonation of the first atomic weapons in 1945.¹ Nuclear weapons proved so destructive that for the first time in history a strategy of purposeful non-use was adopted by states in control of them. As early as 1946, the first generation of nuclear strategists were uncovering the political effects that these weapons would have on international relations.² Overtime, these strategies formed the basis of nuclear deterrence- a strategic concept, which developed and delineated the theoretical necessities required for states to properly deter another states' use of nuclear weapons. The 1950s and 1960s witnessed the explosion of deterrence as an academic sub-field within strategic studies; these concepts forming the foundations of deterrence logic. Academics, such as Herman Khan, Thomas Schelling and others from the 'golden age' of strategic studies, identified the core concepts that inform deterrence studies today.³

Deterrence, at its core, is the study of convincing one's adversary that nothing can be gained from their aggression against your state and its interests; thus it involves convincing them that either your state can deny your adversary their objectives, or that you can so severely punish them as to make the aggression not worthwhile.⁴ Thus, denial

¹ The first atomic bomb exploded on July 16th, 1945 at Alamogordo Air Base in New Mexico. Less than a month later on August 6th and 9th. 1945 the 'bomb' was dropped on Hiroshima and Nagasaki. Graham, John et. al. "World War II. *Encyclopedia Britannica Inc.* Dec.07/18. <https://www.britannica.com/event/World-War-II/Hiroshima-and-Nagasaki>

² Bernard Brodie and others published *The Absolute Weapon* in 1946. The first treatise recognizing the political and strategic problems associated with the "absolute weapon". Dunn, Frederick Sherwood and Bernard Brodie. "The Absolute Weapon: Atomic Power and World Order". New York: Harcourt, Brace, 1946.

³ Freedman, Lawrence. *The Evolution of Nuclear Strategy*. 2nd ed. New York: The Macmillan Press Ltd., 1989; Pg. 181-182.

⁴ Snyder, Glenn H. "Deterrence and Power." *The Journal of Conflict Resolution* (Pre-1986) 4, no. 2 (06, 1960): 163. Pg. 163

and punishment form the two methodologies states can use to deter their enemies.⁵

Technology dictates which method a state will choose to deter its enemies.⁶ Historically, this has meant that defensive technological developments, such as the five-star castle, favour a deterrence by denial strategy. Those building castles in the renaissance period sought to create defensive installations that would deny their adversaries their objectives; rendering aggression pointless. Conversely, offensive technological developments, such as the strategic bomber, favour a deterrence by punishment strategy.⁷ The ability of strategic bombers to penetrate national boundaries, holding domestic populations and infrastructure hostage, was thought to deter enemy aggression.⁸

The development of the atomic weapon in the United States in 1945, and consequent developments in the Soviet Union in 1949 brought deterrence to the fore of strategic studies; having a pre-eminent place in the field by the mid 1950's.⁹ The technological development of such destructive weapons systems, required the creation of complex deterrence strategies in both the United States and Union of Soviet Socialist Republics (USSR). Due to the nature of the bomb, and its first delivery vehicles- strategic bombers-, nuclear weapons naturally favoured a deterrence by punishment strategy. Unlike, past offensive technological advancements, the development of the atomic bomb,

⁵ Snyder, "Deterrence and Power." Pg. 163

⁶ Robert Jervis. *The Illogic of Nuclear Strategy*. (Ithica, N.Y: Cornell University Press, 1989). Jervis argues that deterrence is technologically determined. The strategies and postures states use to deter adversary are referential to the technology they have.

⁷ Craig, Gordon Alexander, 1913-2005, Felix Gilbert 1905, and Peter Paret. *Makers of Modern Strategy: From Machiavelli to the Nuclear Age*. Princeton, N.J: Princeton University Press, 1986. Pg. 736-737

⁸ These are the notions originally expounded by the air power theorists and strategic bombing advocates Giulio Douhet, and others. For a brief historical and theoretical explanation see: Paret, Craig, and Gilbert, *Makers of Modern Strategy*. Ch. 21. Strategic airpower theory thus also informs the academic study of nuclear deterrence; as the conventional predecessor.

⁹ Editors. "Manhattan Project". *Encyclopedia Britannica Inc*. Dec.07/18.

<https://www.britannica.com/event/Manhattan-Project> and Editors. "The First Soviet Atomic Bomb". *State Corporation Rosatom*. <http://www.vniief.ru/en/nuclearcentre/History/Atomicbomb/>

and after it the thermonuclear bomb, seems to have finally provided the requisite punishment necessary to deter aggression between enemies, even in periods of crisis.¹⁰

The utilization of strategic bombers, and then missiles, to threaten entire populations at home, managed, during the Cold War, to deter both parties from initiating war with one another. The rough nuclear parity between the Soviet Union and United States' nuclear arsenals during most of the Cold War, ensured that both parties could adequately punish each other, enforcing mutual deterrence. Rough nuclear parity, achieved during the mid-late 1950's, brought with it a new series of questions focused around strengthening the credibility of their nuclear threats and maintain the stability of their nuclear relationship.¹¹ Strategic stability, is a concept, that examines the stability of a deterrence relationship, and measures the success of a deterrent, not only on its ability to deter, but also to foster a stable strategic balance between its peer competitors. It has been premised, historically and contemporarily, on secure second-strike forces and the retention of a assured destruction capability between states.¹² The concept helps analyze the effects of technological developments on the deterrence relationship; promoting those that support the mutual nature of the deterrent, and managing those that undermine it.¹³

During the Cold War this resulted in the development and adoption of technologies that stabilized the nuclear deterrent, such as the Intercontinental Ballistic

¹⁰ This does not mean that it always will. Indeed, technological advancement such as comprehensive radiological clearing technologies, or comprehensive defensive networks, may change the punishment calculation of states; one day it may not be conceived as punishing enough to deter.

¹¹ Kahan, Jerome. "Security in the Nuclear Age: Developing U.S. Strategic Arms Policy". The Brookings Institution 1975; pg. 144

¹² Freedman, *The Evolution of Nuclear Strategy*. Pg. 185

¹³ *Ibid.*, Pg. 185 Stability is directly related to technology because at its core new technologies can either enhance the deterrent of one party, or they could potentially undermine an adversary's ability to deter. In the latter case they de-stabilize the relationship because they undermine the stable and mutual deterrent between one another.

Missile (ICBM), the Multiple Independently Targetable Re-Entry Vehicle (MIRV) and new doctrines- such as Flexible response.¹⁴ It also resulted in the management and control of technologies that de-stabilized the nuclear relationship, such as anti-ballistic missile (ABM) technology.¹⁵ In 1972 the United States and USSR agreed to the management and control of ABM and limitations on offensive weapons; signing the landmark SALT I Interim Agreement and the ABM treaty.¹⁶ Technologies that enhance the deterrence relationship are adopted and developed, while technologies that undermine the deterrence relationship are managed and controlled. The credibility, and stability of a deterrent must be constantly re-examined, in light of changing technological developments so that in each period sound advice can be given to national governments to consistently re-inforce strategic stability.

Technological development forms the base inputs that go into the strategic calculus of states. In the realm of strategic deterrence new technologies can, on-balance, either enhance strategic stability or undermine it. Technologies that enhance strategic stability, by increasing the credibility of the threat, help create a mutual and thus more stable deterrence relationship. On other hand, technologies that undermine strategic stability, should be managed and controlled. If necessary, arms control serves to manage and control dangerous technological innovation for the purposes of retaining and

¹⁴ ICBM's are developed in the latter half of the 1950's, announced on October 4th, 1957. Flexible Response is announced on July 9th, 1962 by Robert McNamara in Athens. MIRVs are first deployed in the midst of 1970. Editors. "Manhattan Project". *Encyclopedia Britannica Inc.* March 12th, 2019. <https://www.britannica.com/technology/Sputnik>. McNamara, Robert. "No Cities" Speech by Sec. Defense McNamara. Atomic Archive. <http://www.atomicarchive.com/Docs/Deterrence/NoCities.shtml>. Kahan, *Security in the Nuclear Age*.Pg 173

¹⁵ Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems. Entered into Force October 3rd, 1972. *Department of State*. <https://www.state.gov/t/isn/trty/16332.htm>. Commonly referred to as the Anti-Ballistic Missile (ABM) Treaty

¹⁶ "Anti-Ballistic Missile (ABM) Treaty."

maintaining strategic stability- offsetting the likelihood of general war. As technology progresses and new weapons systems are developed it is necessary for academics to re-examine the literature, and delineate whether new systems should be adopted or controlled to retain that vital balance, which has allowed the great powers to refrain from envisioning anything but destruction on the other side of a modern general war.

Hypersonic glide vehicles, in concert with hypersonic cruise missiles, represent the first major offensive strategic weapons development since the development of MIRVs and Maneuverable Re-Entry Vehicles (MaRVs) during the Cold War.¹⁷ As such, they pose the first major offensive technological challenge to strategic stability in the last 40 or so years. Whereas traditional ICBMs, such as the Minuteman III, fly on a ballistic trajectory at roughly Mach 23, the hypersonic glide vehicle travels at speeds currently between Mach 5-Mach10 and at an altitude between 50-100km, all while flying on a unique and maneuverable trajectory (for a brief illustration of the differences between an ICBM, Hypersonic Glide Vehicle, and Hypersonic Cruise Missile see figure 1).

¹⁷ MIRVs were being developed in the latter half of the 1960's and were first deployed by the Americans on a land-based ICBM in 1970. Editors. "Multiple Independently-targetable Re-entry Vehicle (MIRV)". Center for Arms Control and Non-Proliferation. August 28th, 2017. <https://armscontrolcenter.org/multiple-independently-targetable-reentry-vehicle-mirv/>. The first MaRV test flight was conducted in August 1966. The test vehicle was known as the MBRV-1. Ultimately, the Navy scrapped the project. For a brief moment the U.S. army had an IRBM MaRV atop its Pershing II, but this was scrapped after the INF treaty went into effect. Caston, Lauren, Robert S. Leonard, Christopher A. Mouton, Chad J. R. Ohlandt, S. Craig Moore, Raymond E. Conley, and Glenn Buchan. "Effectiveness and Lethality." In *The Future of the U.S. Intercontinental Ballistic Missile Force*, 49-82. RAND Corporation, 2014. <http://www.jstor.org/stable/10.7249/j.ctt5vjxdn.12>. Pg. 69

| Missile System | Operational Date | Launch Platform | Speed | Range | Trajectory | Warhead | Military Utility (Strategic or Operational/Tactical) |
|---|------------------|--|------------------|---------------------------------------|---|--------------------------|--|
| Minute Man III (ICBM) | Currently | ICBM | Mach 23 | 13,000km | Ballistic | Nuclear | Strategic-Nuclear |
| Russian Avangard Hyper-sonic Glide Vehicle | Late 2019 | Traditional Ballistic Missile. In specific, the SS-19-Stiletto, RS-28-Sarmat | Maximum: Mach 10 | Current tests place Maximum 10,000 km | Ballistic until it falls off the ballistic missile (in the first stage of flight) at which point its trajectory is unknown. It takes advantage of aerodynamics to maneuver. | Nuclear or Conventional. | Strategic-Projected Nuclear |
| Chinese WU-14/DF-ZF | 2020 | Traditional Ballistic Missile. In specific, DF-4, and DF-17 ballistic missiles | Maximum: Mach 10 | Current tests place range at 2,500 km | Ballistic until it falls off the ballistic missile (in the first stage of flight) at which point its trajectory is unknown. It takes advantage of aerodynamics to maneuver. | Nuclear or Conventional | Strategic-Projected Nuclear |
| Illustrative Example: Hyper-sonic Cruise Missile (Russian/ Indian Brahmos II) | Currently | Land-based mobile launcher, ships, aircraft | Maximum: Mach 7 | 600 km | Utilizes super-combustion ramjet (Scramjet) to fly to its intended target. Its trajectory is unknown. | Conventional or Nuclear | Operational/Tactical-Projected Conventional |

Figure 1: An Illustrative comparison of Missile Systems. All figures represent current/ near term capabilities. To see an exploration on projected capability see footnote.¹⁸

Technological development in the strategic realm comes with it the corollary possibility that they may either enhance or undermine the strategically stable

¹⁸ The United States is still in the development phase of Hypersonic Glide Vehicles. That being said, their HTV-2 program from the early 2010's was attempting to develop a Hypersonic Glide Vehicle that could fly at Mach 20, and a projected range of 17,000km.

relationships that have existed between the great powers since the end of the Cold War. It is as necessary now, as it was during the great arms control debates of the late 1960s and early 1970s for those in the strategic studies discipline to dedicate cognitive effort to understand whether these systems will stabilize or de-stabilize the strategic relationships between the great powers.¹⁹ Hyperglides stand at the forefront of a host of new offensive and defensive technologies that will impact for better or worse the strategic stability of the modern era. It is incumbent to understand whether these vehicles will positively or negatively interact with strategic stability so that decision makers can make educated policy concerning their adoption and implementation, or control and limitation.

The modern hypersonic missile debate arose in the early 21st century, after the United States abandoned its pursuit of Conventional Prompt Global Strike (CPGS), due to Russian and Chinese fears of warhead indistinguishability.²⁰ Warhead indistinguishability relates to the simple concept that an adversary is incapable of knowing where a missile carries a nuclear or conventional warhead. This ambiguity creates fear, instability, and the potential for accidental over-reaction. In response, American strategists sought to utilize hypersonic missile technology to create a new class of missiles, with new flight paths, that would provide the U.S a prompt global strike.²¹ Over the next decade, hypersonic missile development was relegated to scientists in laboratories, until about the mid-2010s. By 2016, China had conducted its seventh flight test for their DF-ZF hyperglide vehicle, demonstrating extreme maneuvers between Mach

¹⁹ Great Debates occurred in the 1960's through to the end of the Cold War concerning the effects of technology on strategic stability the corollary call to decision makers to either control or adopt certain technologies based on these effects. These debates included ABM, and MIRV.

²⁰ Acton, J. M. (2014, May). TARGET:? Foreign Policy; May/June 2014; 206; ProQuest. 52-57. Pg. 54.

²¹ Acton, James M. "Silver Bullet? Asking the Right Questions About Prompt Global Strike" Carnegie Endowment for International Peace. 2013. Pg. 1.

5-10.²² Similarly, in April of 2016, Russia completed the second test of their Yu-74 hyperglide vehicle, which indicated its ability to maneuver and hit a target within a 10,000 km radius in under one hour.²³ Finally, in April of 2018, Vladimir Putin, President of the Russian Federation, unveiled the Avangard hyperglide vehicle, which will be fielded as early as 2019.²⁴ The United States is also developing hyperglide vehicles, such as the Advance Hypersonic Weapon (AHW).²⁵

Each new technological breakthrough involving the nuclear and strategic sphere has required professionals and academics alike to examine the relationship of these new technologies to strategic stability. It was and still is incumbent to weigh and measure the strategic implications of new technologies on credibility, and stability, making the case either for the adoption or management and control of these new technologies.

Necessarily, the technical characteristics of a hyperglide vehicle will either undermine strategic stability or enhance it.

The academic discussion on the impacts of hypersonic glide vehicles is underdeveloped. An increased pool of what constitutes a security threat, coupled with low-level political violence forced many academics to abandon the existential strategic questions in favour of popular security concerns.²⁶ These developments in the 1990s and

²² Kremeyer, K. "Hypersonics Changing the World." *Aerospace America* 54, no. 11 (2016): pg. 44.

²³ "Hypersonics Changing the World", pg. 44

²⁴ Military & Defense. "Russia's Avangard hypersonic missile system: Russia's Defense Ministry has signed a contract on the serial production of the advanced Avangard hypersonic missile complex". *TASS: Russian News Agency*. Mar.12/18. <http://tass.com/defense/993615>

²⁵ Acton, "Silver Bullet", Pg. 48

²⁶ The 1990s witnessed the explosion of security studies to encompass a variety of security concerns that had been forgotten during the Cold War, such as food and climate to name but a few. The corresponding lack of existential threats involved in the Cold War forced strategic studies to evolve into security studies. Baldwin, David A. "Security Studies and the End of the Cold War." *World Politics* 48, no. 1 (1995): 117-41.

into the first decade plus of the 21st century have left few academic minds interested in the deterrence studies of the Cold War. It is relevant because, very few, if any, academics have sought to analyze the comprehensive implications of hypersonic glide vehicles on strategic stability to date. To date only five academic resources can be found, which describe key facets of the technology and imply strategic implications from those technological capabilities. For example, Yousaf Butt's piece in the *New Perspectives Quarterly* titled *A Hypersonic Nuclear War is Coming*, advises the U.S, Russia, and China to call "a timeout on hypersonic glide vehicle testing and start talking frankly about the risks of the hypersonic arms race going nuclear".²⁷ Butt argues that the unique profile of hypersonic glide vehicles "provides natural immunity from US ballistic missile defenses", because the altitude they fly at are below the region where mid-course interceptors can work.²⁸ Butt's core argument is that hypersonic glide vehicles undermine ballistic missile defenses, and that in a period of crisis they favour a first-use.²⁹ Butt's calls for these vehicles to be controlled by some sort of arms control treaty between the three great powers; or barring that, a tacit agreement to keep them strictly conventional.³⁰

Other pieces focused on more technical and regional aspects of hypersonic glide vehicles, such as James Acton's *Hypersonic Boost-Glide Weapons*, and its *Supplement to Hypersonic Boost-Glide Weapons* and Eleni Ekmektsioglou's *Hypersonic Weapons and Escalation Control in East Asia*.³¹ Acton's pieces detail the strategic history and technical

²⁷ Butt, Yousaf. "A Hypersonic Nuclear War is Coming." *New Perspectives Quarterly* 33, no. 1 (2016): 51-54. Pg. 51

²⁸ *ibid.*, Pg. 53

²⁹ *ibid.*, Pg. 54

³⁰ *ibid.*, Pg. 54

³¹ Ekmektsioglou, Eleni. "Hypersonic Weapons and Escalation Control in East Asia." *Strategic Studies Quarterly* 9, no. 2 (2015): 43. Acton, James. "Hypersonic Boost-Glide Weapons". *Science and Global Security*, 2015, 23:3: 191-219. Acton, James. "Supplement to Hypersonic Boost-Glide Weapons". 2015.

characteristics of hypersonic weapons, tracing their contemporary development from 2003-present.³² Primarily, Acton's pieces are technical, concerning the capabilities of the vehicles, with little strategic thought devoted to the strategic repercussions of the vehicle. He lays out a series of potential strategic implications of the vehicles for further study-payload capacity, speed and maneuverability, their survivability in regard to jamming and missile defenses, and their repercussions on warning times.³³ Acton's work informs the purely technical parts of the puzzle. Regionally, Ekmektsioglou's piece concerning escalation control in East Asia delineates the development of the technology, and then relates it to the particular strategies of the United States and China in the east Asian theatre.

While all the aforementioned pieces inform this work, it is RAND's report *Hypersonic Missile Nonproliferation: Hindering the Spread of a New Class of Weapons* which is the most comprehensive.³⁴ The report delineates and defines the main concepts, such as, what is a hypersonic missile, how many types are there, who's developing them, and what are their readily visible strategic implications. RAND's report in particular identifies a well-thought out strategic implication, that of target indistinguishability.³⁵ Target indistinguishability identifies the inability of actor's to clearly distinguish the weapons destination.³⁶ RAND, also argues hypersonic weapons will result in the

³² Acton, "Hypersonic Boost-Glide Weapons", pg. 192

³³ *ibid.*, "Hypersonic Boost-Glide Weapons" pg 213-214. and "Acton, Supplement to Hypersonic Boost-Glide" pg 6-7.

³⁴ Speier, Richard H., George Nacouzi, Carrie Lee, and Richard M. Moore, *Hypersonic Missile Nonproliferation: Hindering the Spread of a New Class of Weapons*. Santa Monica, CA: RAND Corporation, 2017. https://www.rand.org/pubs/research_reports/RR2137.html. Also available in print form.

³⁵ *ibid.*, Pg. 16-17

³⁶ *ibid.*, 17

devolution of strategic forces' command and control, inevitably increasing the risk of accidental strategic war.³⁷

Each of these pieces have provided information, which has and will continue to inform this work throughout. However, these academic pieces failed to examine the question comprehensively from a strategic stability perspective. The adoption, or control and management of these systems relies on clearly illustrating that on-balance these weapons systems either enhance or undermine strategic stability. Yousaf Butt's piece, disregarded the strategic purposes behind the development of hypersonic glide vehicles by the Russian Federation and China. It failed to recognize that these states were actively pursuing these weapons to enhance their assured destruction capability, and bring increased stability to their relationships with the United States. The notion that the Chinese, and especially the Russians would agree to keep these weapons de-nuclearized undermines their own strategic realities, and un-necessarily benefits an already dominant United States. Indeed, as this paper will make evident later, it seems that Russia and China have developed these weapons specifically to undermine the American qualitative defensive advantages, in the express purpose of bringing more parity to their relationship with the United States.

Acton's and Ekmektsioglou's pieces examined the problem from a mostly technical as opposed to strategic mindset. What their pieces missed unfortunately, is the notion that strategic calculations very often demarcate the area in which technologies can be used- one need only remember the Russian, Chinese concerns with CPGS in the early

³⁷ *ibid.*, Pg. 17

21st century to recognize that just because a technology can do something, doesn't mean it will. Whether or not a particular weapon is technically feasible and tactically valuable does not in and of itself dictate whether it can actually be used. Strategic perceptions about the relationship of certain technologies to certain ends, by oneself and one's adversaries, serves to inform the realistic use of the weapon.³⁸ Still, their pieces have been instrumental in condensing much of the developmental dynamics of the technology in its modern incarnation.

Finally, the issue with the RAND report is that it is chiefly concerned with limiting hypersonic proliferation, due to the threats they see emanating from the spread of these weapons. They intimate that these technologies are destabilizing, but it is unclear whether they are arguing that they are strategically destabilizing or only destabilizing in a crisis. What is evident about the RAND report is that it is not a treatise on deterrence or stability but rather one on proliferation, and although those problems are linked, the report lacks conceptual clarity. Indeed, much of the stability question is left in the background by the report, in favour of intimating that hypersonic's are de-stabilizing, without having actually spoken to the stability question in particular.

³⁸ For example, the primary reason the United States was and continues to be thwarted from creating a global conventional prompt global strike system is due to the fact that its adversaries in Russia and China have intimately linked strategic weapons such as (ICBMs and IRBMs) to strategic deterrence, which has itself been conceptually linked to nuclear weapons and deterrence- much to the chagrin of the United States. For the Russian Federation whether or not a ICBM carries a conventional or nuclear warhead matters little- these systems were designed for strategic purposes, striking deep into adversarial homelands. Modern technology may have blurred the line between nuclear and conventional strategic attack, but inevitably a strategic missile whether nuclear or non-nuclear launched against an adversarial state, for instance its ICBM silos, will be perceived as a strategic attack warranting full retaliation by whichever means necessary. Thus whether hyperglides like it or not, their concept of operations has intimately linked them into the strategic domain- meaning that their tactical utility is limited by the adversary's fear that 1) they do not know where the strike is headed, and 2) they cannot know if the warhead is nuclear or not.

That is the purpose of this paper, to determine the answer to a simple, yet, foundational question: what is the effect of hyperglide vehicles on strategic stability? The argument of this paper is that on-balance nuclear or non-nuclear tipped hyperglide vehicles will enhance strategic stability into the mid-21st century, and as such it is unlikely they will be controlled, but rather will inform a component piece for the re-creation of a rough strategic parity. This is because hypersonic glide vehicles mimic developments during the missile age of the Cold War; their ability to hold hostage the populations of one another's home states, while avoiding ballistic missile defenses, ensure punishment, supporting the deterrent of all involved at the strategic level.

To answer this question, it is necessary to explore the complex interplay of theory and history. It requires a delineation of the key theoretical concepts, which underlie strategic deterrence. It will include a study on stability, Mutually Assured Destruction (MAD), and credibility- with its corollary connection to capability, communication, and political will-. These three concepts in concert with a host of contributing concepts will guide the study's examination concerning the plausible effects of hyperglide vehicles on modern strategic stability. Ultimately, deterrence is also impacted by history, which illustrates how our predecessors dealt with new technologies during the first nuclear age; history provides a framework to understand how these principals of deterrence interacted with the world. An examination of the historical record and its relationship to strategic stability will allow the project to isolate the key variables by which the hyperglide vehicle can test its stabilizing effects. This in concert with a historical case study of MIRVs will test the validity and explanatory power of the theory itself. Together, theory and case

study will provide the necessary framework by which an honest analysis can take place concerning the likely effects of hyperglides on strategic stability into the near future.

Methodologically, the project will proceed in three phases. First it will create a technological and theoretical matrix, using the key concepts which revolve around stability, to provide a comprehensive set of concepts to measure the effects of offensive strategic weapons systems on stability. These concepts will be taken from the classical deterrence literature that emanated from the Cold War; the era which not only gave birth to the strategic study of deterrence but also the one that provided the core theoretical concepts surrounding deterrence, stability, and credibility. The theory will be expounded upon from the highest conceptual level down through into the more specific theoretical and strategic designations that impact strategic stability. The second phase of this study will endeavour to validate its theoretical matrix using the case study of MIRVs from the Cold War. It will test the system and academic community of the time to illustrate the theory's value over and above its antique counterparts. Thus, the second phase is designed to provide evidence illustrating the comprehensive nature of the theory. And third, after testing the theory's validity against history, the project will provide a final analysis on hypersonic glide vehicles. It will utilize the theory to understand the plausible effects of hyperglide technologies upon strategic stability. This section will not only reveal the plausible strategic effects of hyperglides, but it will also attempt to shed light on the reasons behind why the literature itself fails to properly conceptualize the problem of modern strategic deterrence and stability. In so doing it will provide a plausible explanation of the reasons why this work differs from most, and why this works theory provides a more comprehensive understanding of strategic stability. Indeed, this paper's

theory is better placed to offer advice to key decision makers about their policy direction in regard to hyperglides moving forward.

This project will take advantage of the massive resources provided by historic and contemporary literature. It will delve deeply into the primary and secondary source material to answer this study's research question. This requires the study of theory, history, and contemporary strategy to elucidate a proper answer for this question. The primary theoretical literature in the strategic studies domain that arose after the birth of the nuclear era will be used to construct the theory that is necessary to measure the effects of offensive weapons systems on strategic stability. Primary and secondary sources will be utilized to understand the contextual history of the Cold War, which will be used to validate the theory itself. Finally, contemporary primary and secondary sources will be used to examine existing and near future developments with regard to the hypersonic glide vehicle. This section will utilize primary government statements and secondary strategic analysis to understand the concept of operations for the incoming hypersonic glide vehicles, which are to be deployed later this year. That information will form the final inputs to be measured by the theory provided to understand the plausible effects of this weapon on strategic stability in the near future.

Hyperglide weapons are the rational response to the development of mid-course ballistic missile defenses. The United States took advantage of a unique historical and geo-political moment that allowed them to develop defensive systems, that are commonly conceptualized as de-stabilizing.³⁹ Although the United States has a considerable

³⁹ BMDs are not inherently de-stabilizing. For them to be de-stabilizing to a peer-to-peer competitor they have to at a minimum threaten or be perceived to threaten an adversary's retaliatory capability. In this sense a limited BMD capacity is not de-stabilizing because it lacks the requisite capability to threaten a peer

technological and temporal advantage in ballistic missile defences both the Russians and Chinese are developing similar mid-course systems.⁴⁰ Hyperglide vehicles are uniquely designed to subvert these defensive systems- mainly due to altitude, but also maneuverability-, and ensure the survival of its payload from launch to target. A survivable deterrent is a credible deterrent. Although none of these countries will completely abandon traditional ICBMs any time soon, the adoption of this new intercontinental weapon ensures the credibility of their deterrents, thus enhancing the stability of their relationships. As such the Russians, Chinese, and Americans are, and should continue to develop these systems, which ultimately decrease the likelihood of a general nuclear war by making the balance of nuclear terror more stable.

adversary's deterrent. The current U.S. BMD program is designed for rogue states in part of a larger deterrence by denial framework. Its limited capacity does not actually threaten Chinese or Russian deterrent threats at the moment.

⁴⁰ The Russians are currently modernizing their ballistic missile defence network. The Chinese are testing a new mid-course ballistic missile defence. And the United States is in the process of potentially expanding their mid-course and other BM defences. Mattis, James. "Nuclear Posture Review. 2018". Office of the Secretary of Defense. Pg. 9, 11. "Missile Defense Review. 2019". Office of the Secretary of Defense. Pg. 57

Chapter 1: Strategic Stability-Theoretically Speaking

This chapter will unveil the strategic history and concepts that inform the study of modern strategic stability. The purpose of this chapter is to understand what stability is, where it came from, and what concepts are required to measure the effects of technology on it. As such, this chapter will proceed in three phases. The first will outline the contextual history surrounding the development of deterrence studies after the Cold War. Before we begin defining and delineating the concepts necessary to understand strategic stability it is necessary to understand, at least briefly, the development of deterrence studies. This will illustrate where the concepts surrounding strategic stability came from, and more generally recognize the effects of strategic development on theoretical frameworks. In the second phase of this chapter, the specific concepts that impact strategic stability will be defined, delineated, and discussed. These concepts will be explored to show how they are affected by technology, and consequently, how technology influences strategic stability. Finally, this chapter will utilize these concepts to create a comprehensive theoretical framework that can analyze the plausible impacts of offensive weapons on strategic stability. In so doing, this chapter will provide the necessary framework to measure the plausible effects of hypersonic glide vehicles on strategic stability.

Historic Development of Deterrence Studies

The notion that states, groups, or individuals can deter the actions of their adversaries is an ancient one. Indeed, the notion of deterrence is so ingrained in our interactions with one another that it remained strategically unnoticed and underdeveloped until the mid-20th century. As the theoretical frameworks that informed deterrence logics

into the latter half of the 20th century developed, there was an equal recognition that these same logics were utilized throughout strategic history. The threat of massacre to the inhabitants of a walled city under siege, is reminiscent of the nuclear threats posed by states to one-another today.⁴¹ While similarly constructed threats, both genocidal in nature, the nuclear one became all the more credible than its ancient counterpart. It was not the human psyche that changed but rather the technical, cultural and social characteristics of the corresponding threat. The advent of nuclear weapons led to the birth of a new strategic discipline; deterrence.

The explosion of deterrence studies from 1945-1989 did not occur in a vacuum, rather it was the response of academics and professionals alike to this new weapon and the changing geo-strategic balance in the aftermath of World War II. It is not accidental that the study of deterrence is often broken into the study of three distinct eras of deterrence thinking. Before concepts are defined and delineated it is important to understand where they came from. Indeed, deterrence developed from a from a nascent study in the late 1940's to the pre-eminent strategic discipline by the mid-1960's and through till the end of the Cold War.⁴²

The first era takes place from roughly 1945-1955.⁴³ The detonation of two atomic bombs over Hiroshima and Nagasaki in the latter half of 1945 and the increasing

⁴¹ The nuclear threat is a genocidal, or civilizational threat. It is not a new phenomenon. Before nuclear weapons armies had the technical capability to destroy an entire civilization. Thomas Schelling lays out the reality that theoretically total war has not changed, indeed, "With deadly monotony the Persians, Greeks, or Romans [of the past] put to death all men of military age, and sold the women and children into slavery". It is important to remember that total wars, and the threat thereof are not a recent phenomenon. Schelling, Thomas C. "Arms and Influence". Yale University Press. 1966. Pg. 18-21

⁴² Buzan, Barry. "An Introduction to Strategic Studies: Military Technology and International Relations". St. Martin's Press. 1987. Chapter 11-12. Freedman, "The Evolution of Nuclear Strategy".

⁴³ *ibid.*, Pg. 143-144

animosity between the Soviet Union and the United States, beginning the Cold War, would prove to signal the beginning of a new strategic study, one revolved around the purposeful non-use of weapons.⁴⁴ By 1946, Bernard Brodie and others published *The Absolute Weapon*, a seminal piece in deterrence studies.⁴⁵ It recognized that the destructive potential associated with nuclear weapons, coupled with the relatively recent development of the long-range bomber meant that entire societies could be held hostage for political purposes; societies could be so threatened that war might be avoided.⁴⁶ The recognition of nuclear weapons' utility as a political tool rather than a military tool fundamentally changed the way policy makers in the Western world perceived the weapon. The first era developed the broad concepts surrounding nuclear deterrence, nuclear blackmail, and at the time, assured destruction, and mutual annihilation.⁴⁷ During this period the United States had a relative monopoly on nuclear weapons. At the level of policy this led to the adoption of a strategy known as Massive Retaliation.⁴⁸ The Eisenhower administration's doctrine of Massive Retaliation, threatened the Soviet Union with a swift strategic nuclear attack that would quite literally bomb the Soviet Union "back to the stone age" if they started a war against American allies in Europe.⁴⁹

⁴⁴ Bernard Brodie writes, "Thus far the chief purpose of our military establishment has been to win wars. From now on its chief purpose must be to avert them. It can have almost no other useful purpose". Edited by Brodie, Bernard. "The Absolute Weapon: Atomic Power and World Order. New York: Harcourt, Brace, 1946. Pg. 62

⁴⁵ *ibid.*

⁴⁶ *ibid.*, Chapters 1-2.

⁴⁷ *ibid.*, Chapter 1-2. and Brodie, Bernard. "Strategy in the Missile Age". Princeton University Press. 1959. Chapter 5-6.

⁴⁸ John Foster Dulles, Secretary of Defence to Eisenhower announced the Massive Retaliation Doctrine on January 12th, 1954. In his address Dulles stated that the United States would "depend primarily upon a capacity to retaliate instantly by means and places at our choosing". "It came to be known as the doctrine of instant and massive retaliation". Chapter 2, Peeters, Paul. Massive Retaliation: The Policy and its Critics. Vol. no. 2. Chicago: H. Regnery Co, 1959. Pg. 16

⁴⁹ Fergusson, James. "Canada and Ballistic Missile Defence". Pg. 28

Unfortunately, for the United States, events in the early to mid-1950's changed the strategic situation such that the second era of deterrence studies had begun- 1955-1965.⁵⁰ By the latter half of the 1950's the Soviet Union was reaching toward a rough nuclear parity with the United States- which they would achieve by the mid1960s; fundamentally, altering the strategic situation away from a U.S. dominated assured destruction, to a new strategic situation defined as Mutually Assured Destruction.⁵¹ In this new paradigm both nations' nuclear arsenals were capable of holding one another's hostage. The mutual nature of destruction created the strategic situation that would lead to the fullest development of nuclear deterrence theory.⁵² In light of this new situation academics such as Herman Khan and Thomas Schelling recognized unique problems associated with the credibility of the American deterrent. In their studies on credibility and its essential relationship to communication, capability, and political will it was revealed that the American deterrent lacked credibility. Massive Retaliation- a strategy enunciated by the Eisenhower administration in 1954- relied on the American commitment to utilize strategic weapons immediately against the Soviets if they encroached on Western Europe.⁵³ However, the new Soviet strategic arsenal now meant that the Americans were forced into a position where they would have to decide whether in war to trade the cities of Bonn, Paris, Rome, and Berlin for Los Angeles, New York,

⁵⁰ Buzan, *An Introduction to Strategic Studies*. Pg 147-155

⁵¹ *ibid.*, Pg. 147-149.

⁵² The transition from a unipolar nuclear order to a solidly bipolar one provided the stimulus for theoretical development of the Golden Age. This period contained the mass of theoretical development of state-to-state deterrence. It birthed the concepts of stability, credibility, counterforce, extended deterrence and arms control to name but a few. *ibid.*, Pg. 148-150.

⁵³ Kissinger, Henry A. "Nuclear Weapons and Foreign Policy". Council on Foreign Relations Inc. 1957; Pg. 128

Washington D.C, or Chicago.⁵⁴ The perception among the academic community at the time, was that no president would credibly trade domestic civilizational destruction for even the most honoured of allies, making the deterrent a mirage.⁵⁵ Associated with the problems of credibility came the development of specifically strategic concepts in regards to nuclear war. Given the intensity of the threat of mutually assured destruction, academics began to focus on how to ensure the non-use of nuclear weapons between the two nuclear armed superpowers. These studies generated a series of new concepts that were designed to delineate the specific functions, utilities, and effects of force structure, doctrine, and military technology on deterrence. The concepts of counter-value vs. counter-force, arms race stability, crisis stability, controlled reprisal, and the escalation ladder became key strategic and academic concepts utilized in the study of strategic deterrence.⁵⁶

Theoretical development during the second era impacted American policy makers, leading them to abandon the doctrine of Massive Retaliation, replacing it in 1962 with the Flexible Response doctrine. Announced on July 9th, 1962 in Athens, Robert McNamara unveiled the United States' Flexible Response strategy, which took advantage of increased theoretical clarity to develop a strategy that was increasingly credible; utilizing a conventional and nuclear deterrent that was so mixed as to provide flexible options for escalation up and down the conflictual ladder.⁵⁷ By this period the relationship between stability, deterrence, and MAD had become solidified, such that

⁵⁴ This notion has been repeated by a host of deterrence sources. For specific reference see- Fergusson. "Canada and Ballistic Missile Defence". Pg. 30

⁵⁵ *ibid.*, Pg. 30

⁵⁶ Schelling, Thomas. "Arms and Influence". Herman Khan. "On Escalation: Metaphors and Scenarios". Penguin Books. 1965.

⁵⁷ McNamara, Robert. "No Cities Speech". <http://www.atomicarchive.com/Docs/Deterrence/Nocities.shtml>

doctrine, posture, and technology were consistently measured against its ability to foster a strategically stable situation between the Soviet Union and United States. Stability became directly associated, for good reason, with mutual vulnerability of each state to one another's strategic weapons.⁵⁸

By the latter half of the 1960's the purpose of deterrence, and stability, was clear, the methodology, mutually assured destruction, were sound, and the methods, credibility and its association to strategic concepts, developed, so that each state had the requisite tools to deter one another. Thus the third era of deterrence 1965-1989, dealt with the problems around ensuring the stability of the strategic relationship, on the premise of MAD, in light of the technological developments of the day. By late 1960's intercontinental ballistic missiles (ICBMs) had become the primary delivery system for first strike nuclear forces, and Submarine Launched Ballistic Missiles (SLBMs) and long range bombers had likewise become the primary delivery systems for a second-strike.⁵⁹ Ultimately, MAD depended upon the capability of second strike nuclear forces to deter one's adversary.

However, offensive and defensive technologies co-develop so that as soon as the first generation of ballistic missiles was complete so too had military planners begun conceptualizing of defensive systems. From this came the nascent Anti Ballistic Missile (ABM) programs of the United States and Soviet Union, which had begun to be implemented in the late 1960's.⁶⁰ Almost immediately, academics recognized the

⁵⁸ Gray, Colin S. "Strategic Stability Reconsidered." *Daedalus* 109, no. 4 (1980): 135-54. Pg 136

⁵⁹ Fergusson, James. "Canada in the Ballistic Missile Age". Pg. 27

⁶⁰ By the latter half of the 1960's both the United States and Soviet Union began developing Anti-Ballistic Missile Systems. At the time these were the U.S. Spartan System and the Soviet Galosh system. Editors.

problem associated with ABM programs. Fundamentally, defensive programs, especially ballistic missile defence, were recognized as threats to the mutual vulnerability, which lies at the heart of nuclear stability. The connection of stability to mutual vulnerability as elucidated by historic arms controllers meant that these weapons had to be controlled for strategic purposes to create a more stable nuclear relationship.⁶¹ These ideas spurred the arms control movement into the 1970's and beyond, with landmark agreements such as SALT I, the Vladivostok Accords and SALT II.⁶²

The events of the Cold War created the necessary conditions for the definition and development of a complex deterrent relationship. It intertwined the concepts of stability, deterrence, and credibility to such an extent that we still utilize these concepts to understand the broad relationship between the great powers today. Although, the strategic situation changed rapidly after the fall of the Soviet Union in 1991, the basic foundational relationship between the United States, Russia, and China relies upon a nuclear deterrent, which is premised on mutual vulnerability and mutually assured destruction. The first era of nuclear deterrence studies elucidated the concepts of assured and mutually assured destruction. The second era developed a mass of strategic concepts to simplify and comprehend nuclear weapons and nuclear war. The third era, defined the desirable strategic relationship and consistently attempted to measure the effects of strategic weapons, doctrines and postures on this relationship. From each of these era comes

“Antiballistic Missile (ABM)”. Encyclopedia Britannica. February 28th, 2018.

<https://www.britannica.com/technology/antiballistic-missile>

⁶¹ Leonard S. Rodberg (1967) ABM and arms control, *Survival*, 9:10, 331-336.

⁶² SALT I consisted of two agreements: “Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics On Certain Measures With Respect To The Limitation of Strategic Offensive Arms (SALT I)”, and the “Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems”. SALT I was ratified in 1972. The Vladivostok Accords Occurred in 1974. SALT II talks were completed in 1979 but never ratified.

important conceptual frameworks that are necessary to create a comprehensive theoretical matrix, which can plausibly predict the effects of new weapons systems on strategic deterrence. In the next section, this paper will define and delineate the specific concepts necessary for the creation of this matrix.

Concepts

The deterrence studies of the Cold War continue to provide the concepts necessary to understand and measure strategic stability. From these studies, three core concepts were unveiled: deterrence, stability, and credibility. Each of these concepts will be defined, as each one is pertinent to the study itself. Stability is the goal, deterrence is the methodology, and credibility is the methods. For conceptual reasons this section will proceed first by outlining precisely what deterrence is, and what a general deterrence relationship looks like. Then it will discuss stability itself and its corresponding concepts of arms race and crisis stability. Finally, this section will discuss credibility, and its corresponding relationship to escalation, and counter-value and counter-force weapons.⁶³ From these concepts it will become possible to create a theoretical matrix that can accurately comprehend the plausible effects of new technologies, such as the hypersonic glide vehicle, on strategic stability.

⁶³ For a more thorough understanding of the above concepts see: Bernard Brodie's *The Absolute Weapon*, Thomas Schelling's *Arms and Influence*, Herman Khan's *On Escalation*, Lawrence Freedman's *The Evolution of Nuclear Strategy*, Henry Kissinger's *Nuclear Weapons and Foreign Policy*, Jerome Kahan's *Security in the Nuclear Age*, Patrick Morgan's *Deterrence a Conceptual Analysis*, Barry Buzan's *An Introduction to Strategic Studies*, and James Fergusson's *Canada and Ballistic Missile Defence* all served to inform the formulation of the theory expounded on in this chapter.

Deterrence

It was from the study of deterrence, that the desirability of a strategically stable relationship was uncovered. Thus deterrence as a concept must be discussed. It will be easiest to define deterrence and then discuss it more thoroughly. A useful definition for deterrence comes from Yehoshafat Harkabi, he wrote:

“Deterrence is the inducement of another party...to refrain from a certain action by means of a threat...to inflict retaliation or punishment...In other words deterrence is persuading the deterred that his own interest compels him to desist from committing a certain act”

“Such persuasion is achieved by calculations of gain against loss...To make deterrence effective, the deterrer makes certain that the level of retaliation...overrides the gain the deterred anticipates...To the extent that such an action is motivated by psychological impulse rather than calculations of gain, the strength of the deterrent threat must of course also offset the pressure of such impulses”⁶⁴

A more simple definition of deterrence looks something like this; deterrence means “that State A seeks to prevent State B from doing Z by threatening B with unacceptable costs if it does Z”.⁶⁵ The basic concept is that states have interests, communicate those interests to their adversaries, and communicate a threat to their adversaries, should they intervene on that interest. It is the threat of violence, of potential cost, that seeks to change an adversary’s calculus away from doing what they wish to do.

In the modern world, between states, these threats can be one’s of denial or ones of punishment.⁶⁶ A threat of denial illustrates to one’s adversary that even if they attempt to aggress their aggression will be futile; the futility of the situation convinces the adversary not to attack. Punishment on the other hand, allows the seeks not to deny the attack from occurring, but threatens punishment on such a scale as to override any potential benefits

⁶⁴ Morgan, Patrick. “Deterrence: A Conceptual Analysis”. SAGE Publications Inc. 1977. Pg. 22

⁶⁵ *ibid.*, Pg. 19

⁶⁶ Snyder, “Deterrence and Power.” Pg. 163

from said aggression. Necessarily, technology informs the specific type of deterrence states use against one another. In the nuclear era, between peer competitors, the type is punishment; it is threat of escalation to total war, and corresponding civilizational costs, that the three great powers use against one another today. Deterrence between peer nuclear powers is a threat of mutual assured destruction. Wherein the punishment involves a threat to the very existence of the state.

Conceptually deterrence is relevant, because it represents the methodology that states use to pursue stability. Ultimately, deterrence is directed toward deterring war, and as such it is equally directed toward pursuing stability. Deterrence pursues stability because a strategically stable situation is the one that is least likely to go to war, whereas, as strategically unstable situation raises the risks of war.

Stability

By the mid-1960's a stable nuclear balance, and nuclear deterrence had become intertwined.⁶⁷ Deterrents were thus directed towards the maintenance of a stable strategic relationship. Theoretically speaking a stable deterrent relationship can be premised upon one of two strategic relationships. Either it can be one of strategic supremacy or one of strategic parity.⁶⁸ A asymmetrical supremacy, allows for stability because one party is clearly dominant over the other, thus deterring the others actions. In these circumstances the weaker party faces a one sided existential threat, and thus will not risk war with its superior adversary. Stability in this sense requires that the supreme state stay far enough ahead of its counterpart so as to successfully convince them that aggression is

⁶⁷ Gray, "Strategic Stability Reconsidered."

⁶⁸ *ibid.*, Pg. 136

inconceivable. Stability via supremacy is threatened when the relationship begins to shift to parity- because miscalculation of strength on both sides increases the likelihood of war.⁶⁹

Strategic parity exists when each actor has the capability to deter the other.⁷⁰ Rough parity, in the modern world, requires the mutual vulnerability of each state to the other's assured destruction capability. It is threatened when the mutual nature of the deterrent is undermined by the adoption of technologies that undermine the mutual nature of the states' deterrent. When one state is perceived to be reaching toward a denial capability, incentives arise for the peer competitor to strike before this capability is realized. This strike is induced because the peer does not wish to lose their capability and associated political power. The current strategic relationship between the three great powers today is one that is premised upon a rough strategic parity. Yet, the general concepts surrounding stability are not the only one's we must be concerned with. Arms race and crisis offer two unique lenses that specifically speak to the effects of technology on deterrence.

Arms race stability relates to the basic engine of competition whereby one actors first strike is encouraged by the other actors investment in defensive or offensive programs that threaten their ability to wreak massive societal damage with their second strike forces.⁷¹ As Colin Gray puts it, "a stable arms competition is one wherein neither side invests in programs that the other would view as a challenge to its assured

⁶⁹ It is not an historical accident that the most unstable period of the Cold War occurred in the early 1960's- the Berlin Crisis 1961 and the Cuban Missile Crisis 1962. This was the period when the Soviet Union was moving decidedly from inferiority to parity with the United States.

⁷⁰ Buzan, *An Introduction to Strategic Studies*. Pg 145.

⁷¹ Gray, Colin S. "Strategic Stability Reconsidered." Pg. 144-146.

destruction capability, and hence would not be motivated to offset”.⁷² At its most basic level arms race stability recognizes that if a state is able to stimulate weapons production among its adversaries, so too could it stimulate restraint and thus induce its adversary to restraint as well.⁷³

Arms race stability, especially as conceived during the Cold War, was based on the assurance that neither power would pursue weapons technologies that undermined the mutual nature of assured destruction. Arms race stability codified the concept that strategic stability was correlated toward mutual vulnerability.⁷⁴ As a concept arms race stability underscores the specific impacts that technology has on the strategic balance between states.

Crisis stability, on the other hand, refers to the strategic condition wherein the “very character, readiness, and mobilization procedures of the armed forces in confrontation should not themselves comprise the proximate cause of war”.⁷⁵ As Thomas Schelling notes, crisis stability relates to the affects of “weapons, organizations, plans, geography, communications, warning systems, intelligence, and even beliefs and doctrines about the conduct of war” that together have an influence on the likelihood and conduct of a potential war.⁷⁶ Similar to arms race stability, crisis stability seeks to recognize whether certain technologies, in a crisis, would either stabilize or de-stabilize

⁷² *ibid.*, Pg. 144

⁷³ *ibid.*, Pg. 144

⁷⁴ Ultimately, it is unclear whether Arms Control works, and has the desired outcome on stability. Still its track record during the Cold War offers some evidence, however scant, that the Soviet Union and United States both ideological and geo-political rivals at the time readily utilized the concept to create a stable deterrence relationship, setting the boundaries on a stable strategic relationship. Gray, Colin. “Strategic Stability Reconsidered” Pg. 142 and Fergusson, James. “Canada and Ballistic Missile Defence”. Pg. 72

⁷⁵ Gray, “Strategic Stability Reconsidered.” Pg. 146

⁷⁶ Schelling, Thomas. “Arms and Influence”. Pg. 234

the relationship, and offer incentives for the parties to fall into war. It differs from arms race stability in general due to its relationship to a particular crisis at a particular time. As a concept crisis stability offers a conceptual lens to examine the impact of technological imperatives on incentivizing war in a crisis.

Crisis and arms race stability provide the requisite concepts to help measure the effects of an offensive weapons technology on strategic stability. Both of these concepts offer unique lenses through which modern technology might be examined as either stabilizing or de-stabilizing, and thus new technologies must be investigated under the auspices of both theoretical frames to accurately understand the effects of these two lenses on a broader strategic stability.

Credibility

Credibility is intimately linked to deterrence and stability. A deterrent is only useful, if your adversary believes it to be credible. An incredible deterrent is incapable of deterring because it fails to convince one's adversary that punishment will actually follow the attack. Without a credible deterrent a strategically stable relationship will inevitably devolve into an unstable relationship. Consequently, a credible deterrent is fundamentally necessary for the creation of a stable strategic balance.

The credibility of a deterrent rests upon three foundational concepts, each of which are necessary to the creation of a credible deterrent vis-à-vis an adversary. Ultimately, a deterrent is not just the sum of a state's capabilities, but rather the perception that the state is willing to use their capability when confronted. It is subject to miscalculation and misperception, but inevitably, a theoretically credible deterrent is the

most capable of convincing one's adversary of its legitimacy. The formation of a theoretically credible deterrent relies upon communication, capability, and political will.⁷⁷

Strategic communication is the foundational component of a credible deterrent. It is inconceivable to deter without communication, and thus communication represents the first piece of the deterrent puzzle. It requires a declaration of interest in a specific outcome and the communication of punishments in retaliation for the abrogation by another party of those outcomes.⁷⁸ Communication is necessary for both capability and political will to be relayed to one's adversary. In this sense, capability and political will both rely on communication as well. Capability and political will must be communicated in order for an adversary to understand a deterrence relationship exists. During the Cold War, communication between the superpowers was consistent, and ranged from treaties, to declarations, to posture, and force structure. For example, the NATO treaty clearly identifies the United States' interest in the status quo for Western European sovereignty and clearly communicated a threat for general war with the Soviet Union, should their sovereignty be encroached by Soviet Forces i.e. Article V of the North Atlantic Treaty.⁷⁹

⁷⁷ Herman, Khan. "On Escalation". Schelling, Thomas "Arms and Influence". Morgan, Patrick. "Deterrence".

⁷⁸ Morgan, Patrick. "Deterrence". Ch. 1

⁷⁹ Article 5 of the North Atlantic Treaty Reads The Parties agree that an armed attack against one or more of them in Europe or North America shall be considered an attack against them all and consequently they agree that, if such an armed attack occurs, each of them, in exercise of the right of individual or collective self-defence recognised by Article 51 of the Charter of the United Nations, will assist the Party or Parties so attacked by taking forthwith, individually and in concert with the other Parties, such action as it deems necessary, including the use of armed force, to restore and maintain the security of the North Atlantic area". It lays out the interest and response- although not specifically- to the abrogation of NATO members sovereignty. "The North Atlantic Treaty". North Atlantic Treaty Organization. Signed in Washington D.C. April 4th, 1949. https://www.nato.int/cps/ie/natohq/official_texts_17120.htm

Just as a credible deterrent requires communication, so too does it require the technical, doctrinal, and postural components necessary to follow through on one's threat. A threat without capability is simply a bluff. It would be unwise to suggest that a credible deterrent can be formed without the requisite capability to follow through on one's threat.⁸⁰ A bluff is de-stabilizing because it may be called. Without the demonstration of one's capability the credibility of the deterrent is threatened. During the Cold War the United States, Soviet Union, China, and others all conducted various nuclear tests to demonstrate their capability to follow through on their nuclear threats.⁸¹

Finally, a credible deterrent requires a state have the political will necessary to follow through on their threat. The political viability of retaliation has to have the necessary political will from decision makers, or else it is simply empty words. Political will due to its relationship with the human psyche is uniquely vulnerable to misperception, and miscommunication. The associated costs of a general war in the 21st century have made the political will problem unique. For instance, if a first strike is conducted against one's counter-force capabilities- military targets- typically located outside one's population centres, the receiving party has to contemplate retaliation recognizing that a potential third strike would result in the destruction of counter-value targets-i.e. cities. This problem requires the decision maker to weigh their population

⁸⁰ Credibility is intimately linked to the perceptions about whether a threat warned is genuine or not. Even having signaled an interest if there is a perception of a corresponding lack in political will then missteps can be taken. During the Korean War, the Chinese warned the United States of the consequences of crossing the Yalu River. Unfortunately, the Americans either misunderstood or misperceived these warnings to be a bluff. This is an instance where perception of the political willingness to follow through on one's threats was misperceived. Schelling, Thomas. "Arms and Influence". Pg. 54-55.

⁸¹ Over the course of the Cold War each of the three parties conducted tests of their nuclear weapons to signal their capability to their adversaries, one such example is Operation Starfish Prime in 1962. Operation Starfish Prime involved the detonation of a 1.4 megaton warhead in the upper atmosphere, resulting in a communications blackout over the Pacific. Fergusson, James. "Canada and Ballistic Missile Defence". Pg. 26

against actually following through on their threat, however, if they do not follow through, or are perceived to not be willing to follow through, then there is in fact no deterrent whatsoever.

For example, historically decision makers dealt with the political will problem by instituting the trip-wire strategy. The United States sought to bolster their deterrent by putting American soldiers on the western flank of the Soviet Union.⁸² The strategic calculus being that American ‘trip-wire’ forces dying in battle against the Soviet Union would so spur the domestic political will within the United States to escalate to nuclear weapons; forcing the decision makers to follow through on their deterrent threat. The trip-wire more readily convinced the Soviet Union of American will because it raised the risks around initiating even a limited war in western Europe. These trip-wire strategies recognize the need for incentives or triggers to enhance the domestic political will required for states to follow through on such high-consequence threats. Inevitably, political will, and the problems associated with it are directly proportional to the threat that is needed to be carried out.⁸³

Credibility is also impacted by the effects of technology. The associated concepts of counter-force, counter-value, and escalation provide useful lenses to comprehend the particular effects of technology on credibility more broadly.

⁸² Lt. Col. Peter F. Wittereid, USA. “A Strategy of Flexible Response”. US Army War College. 1972. <https://ssi.armywarcollege.edu/pubs/parameters/articles/1972/wittereid.pdf>

⁸³ A deterrence threat is always relative. The threat has to relate to the object in question and its relative importance to state interests. For example, a threat of nuclear retaliation against a terrorist attack is not credible, because it lacks the political will necessary to follow through. It seems evident that proportionality is an relatively important concept between the great powers; such that historically nuclear deterrence threats have not been directed towards anyone but state actors, and even then it is still connected to strategic attacks.

Escalation and controlled reprisal were concepts developed most clearly by Herman Khan and Thomas Schelling. Schelling recognized that in even if a limited conflict broke out between the two superpowers, nuclear weapons still retained the ability to deter further escalation via the utilization of controlled reprisal.⁸⁴ Intuitively, if nuclear weapons were designed to threaten populations then its possible that limited strikes could be carried out to signal to one's adversary their will to engage in a conflict; demonstrating the costs associated with further escalation, and the willingness to move forward.⁸⁵ Herman Khan, likewise developed the escalation ladder, which communicated the same notion.⁸⁶ Khan argued, that states will often escalate to prevent something worse from happening.⁸⁷ Escalation serves political purposes by threatening an adversary with a worse outcome if they should choose to move forward. In recognition of this fact Khan developed a theoretical escalation ladder to illustrate the potential actions that could be taken to escalate for the purposes of de-escalation. In specific he included the notions of thresholds, where each power might re-examine his or her position and re-evaluate the costs and benefits of continued action.⁸⁸ In both cases, their studies⁸⁴ revealed the complex interplay of strategy in a potential nuclear war, unveiling new theoretical concepts which could be directly applied to the purpose, intention, and stability concerns surrounding particular force structures and doctrine. From these discussions escalate to de-escalate strategies were adopted by the United States, because they increased the credibility of the

⁸⁴ Schelling, Thomas. "Arms and Influence" Chapter 3-4

⁸⁵ Schelling speaks explicitly about the utilization of limited war as a generator of risk. He argues that limited war, carries with it a deterrent to continued aggression. He writes "The threat to engage in limited war has two parts. One is the threat to inflict costs directly on the other side, in casualties, expenditures, loss of face, or anything else. The second is the threat to expose the other party, together with oneself, to a heightened risk of a larger war". *ibid.*, Pg. 105

⁸⁶ Khan, Herman. "On Escalation".

⁸⁷ *ibid.*, Pg. 4

⁸⁸ *ibid.*, Pg. 41-51.

American deterrent in Europe. In this sense, escalation provides a unique strategy that increases the credibility of one's deterrent. If a state actually considers the strategies to fight a nuclear war, they will be perceived as more credible by their adversary.

Connected to the idea of escalation was the concept of counter-force and counter-value weapons, which offer a unique lens that helps us to understand the effects of a technology on stability. Strategic weapons systems are traditionally connected to either a counter-force or counter-value designation. These designations impact the credibility of one's deterrent. During the Cold War, strategists quickly recognized the theoretical separation between two types of target sets for strategic weapons; counter-force and counter-value. Counter-force targets represent military and associated industrial assets, which can be targeted to diminish an opponents ability to strike back.⁸⁹ Counter-value targets represent societal and civilian targets, such as cities.⁹⁰ In its infancy nuclear weapons were primarily directed toward counter-value targets.⁹¹ Originally, the relative costs of a strategic nuclear strike against one's counter-value targets served as the basis of deterrence. Unfortunately, as nuclear parity was achieved between the Soviets and Americans, complex strategic calculations were made about precisely what one targets at each point in a nuclear war, especially if said power wished to win the war. As a political tool, nuclear weapons require a state to hold their adversary's counter-value targets hostage. Hitting the enemy's cities immediately, would eliminate the possibility of de-escalation. This entails that an immediate strike against an enemy's cities would, in the

⁸⁹ Schelling, Thomas. "Arms and Influence".

⁹⁰ Fergusson, James. "Canada and Ballistic Missile Defence". Pg. 27

⁹¹ American nuclear strategy, from roughly 1945-1960, was premised upon the utilization to fully destroy the Soviet Union if they encroached on Western Europe. Long-range bombers were designed to destroy the Soviet society via strategic bombing. As the arsenals grew, weapons began to be conceptually separated according to either a primary role as a counter-force or counter-value weapon.

context of MAD, lead to the destruction of your own population.⁹² Theoretically separating counter-force and counter-value weapons and recognizing their relative purposes in a general war, suggest that counter-force weapons may be more credible and therefore more stabilizing. If deterrence by punishment rests ultimately on holding an enemy's population hostage, then striking counter-value targets has no utility in de-escalating a crisis. In this sense counter-force weapons are stabilizing because they offer decision makers the requisite tools to de-escalate in a crisis, and avoid general nuclear war.

The concepts detailed above are the most relevant for understanding stability. Each of the three major concepts- deterrence, stability, and credibility- provide the necessary lenses to understand the affects of offensive weapons systems on strategic stability. Deterrence describes the foundational relationship upon which stability is conceived and premised. This relationship is impacted by technology through its affects on arms race and crisis stability. Finally, the affects of a technology on communication, capability, political, and its interactions with escalation and counter-force and counter-value are too necessary to conceptualize the technology's impact more broadly on credibility and therefore stability.

Theoretical Matrix

Each of the concepts discussed above help inform the creation of the following theoretical matrix below, that looks at the impact of technology on strategic stability. This section will begin first by demarcating the bounds of the theory. Then it will discuss

⁹² Schelling, Thomas. "Arms and Influence". Pg. 191

the assumptions of the theory. Finally, it will lay out the theory itself. In so doing the theory will be designed to be as comprehensive as possible, and thus provide the framework necessary for the examination of the impacts of offensive weapons systems, such as the hypersonic glide vehicle, on strategic stability.

Theoretical Limitations and Assumptions

Before diving explicitly into the concepts necessary to create a theory, which measures the impacts of technology on strategic stability, it is first important to de-limit the theory according to its specific scope. The technical characteristics of hypersonic glide vehicles offer just such a natural de-marcation of the theory's bounds. The concept of operations for the planned deployment of hyperglide vehicles is to place them atop ICBMs. The theory will be constructed to examine the effects of strategic offensive weapons systems; to create a theoretical framework to measure their effects on strategic stability. As such it does not explore the effects of defensive systems, doctrine, or strategic postures on strategic stability. Furthermore, the complex nature of these weapons systems means that they are solely within the purview of states. The modern state system has tied violence and war to the state itself, such that strategic weapons development currently only occurs at the state level.

This means that a theory attempting to understand the affects of technology on strategic stability is solely concerned with classical state-to-state deterrence. As such this theory will not take into account the conceptual differences, and more important difficulties, associated with lower level actors, such as groups or individuals. Finally, in regards to the technical limitations, it is important to remember that hypersonic glide vehicle development stands within the purview now and into the near future, of the three

great powers- America, Russia, and China. Lastly, the theory does not incorporate strategic culture into its analysis. The complexity of discussions concerning strategic culture makes such an assessment beyond the scope of this paper. Instead, the theory is designed to measure outside of specific strategic cultures the plausible impacts of technology based on a more general strategic relationship. As such it looks to describe the likely affects of an offensive weapon system on strategic stability, outside of domestic and cultural perceptions about the system itself. In this sense it is directed towards the plausible affects that the technology will have on strategic stability.

All theories by their nature assume a variety of things about the state affairs, and from those assumptions create theoretical frames that attempt to understand the complex world of action and re-action. This theory has identified three assumptions, which are relevant and will described and explained.

The first assumption, is that the purpose of strategic deterrence between the great powers, at least since the 1960's, has been one that is directed toward avoiding a general nuclear exchange. The purpose of strategic deterrence is not to deter every and any conflict, but rather is designed to deter a general exchange between strategic adversaries. As early as the 1960's the United States adopted a deterrence premised on the capability to fight and escalate as required, for the direct purpose of increasing their credibility, and deterring a general nuclear exchange. The United States retains this logic, and the Russian Federation has adopted a similar escalate for the purposes of de-escalation

strategy.⁹³ These strategies indicate that the parties are attempting to deter not specifically any conflict but rather a general nuclear exchange.

The second assumption, is that mutually assured destruction still represents the fundamental strategic relationship between the great powers today. Some argue that China lacks the requisite forces for assured destruction, however, this paper argues that specific strategies, such as launch on warning, mean that in a crisis, the Chinese to this day retain their assured destruction capability. Although the United States is conventionally superior, all three great powers exist in a state of rough nuclear parity, each retaining the ability for assured destruction. The third and final assumption of this paper's theory, is that escalate to de-escalate strategies are credible, and logically formidable ideas. This paper argues that it is plausible that strategic escalation offers decision makers the ability to refocus their interests and examine more readily the consequences for further escalation, increasing the likelihood of de-escalation, thus avoiding escalation into general nuclear war.

Each of these three assumptions impact how the theory understands stability, and thus how it measures the impacts of offensive weapons on stability. In light of these assumptions it now becomes possible to construct the theoretical matrix, which will be used later to measure the plausible affects of hypersonic glide vehicles on strategic stability. As such the scope of this paper is limited to state based interactions between great powers, concerning the impact of offensive weapons systems on strategic stability within these relationships.

⁹³ Robert Work and James Winnefeld, Testimony before the Committee on Armed Services, (U.S. House of Representatives, 25 June 2015), 4.

Theoretical Matrix

Each of the concepts described above will be utilized to create the theoretical matrix below (see figure 2 below for a visual representation). Each concept offers unique insights into the formulation of this theory. Moving forward the theory will lay out each of the corresponding measures of stability and how they are perceived to function vis-à-vis offensive weapons. It will begin at the most explicit end of the matrix and from there work up to stability itself. Thus theory starts with credibility and its associated concepts. From there it moves up into the theoretical implications on deterrence relationship writ large. And finally, it examines the particular impacts of the technology on stability itself.

Credibility is the first measure, as it is the one most easily understood. The theory asks at this level, how does the new offensive weapon system impact credibility? It gets to this answer by asking four corollary questions. Is the weapon designated primarily as counter-force or counter-value, and what are its impacts on credibility? What is the weapons utility in escalation, and how does this impact credibility? What are the plausible impacts of the weapon on communication capability, and political will? And in light of this information does the weapon enhance or decrease the actor's credibility? If the answer to the last question is that the weapon enhances the state's credibility, then there is evidence that stability is enhanced. An incredible deterrent undermines stability, because it incentivizes aggression from one's adversary. Thus a strategically stable relationship requires a credible deterrent.

The first task of the measure of credibility is to understand the impacts of the weapon, and recognize its strategic purpose in state force structures. By this measure counter-force weapons enhance credibility, because they unlike their counter-value

siblings, are useable in a crisis for the purposes of escalate to de-escalate. Counter-value weapons undermine credibility, because they lack usability in all but a final nuclear exchange. The second task of this measure is to discover if there are any unique impacts from the weapon on escalation due to their technical characteristics. If there are unique and usable escalatory roles for the weapon, it can be said to enhance credibility. From these technical impacts it becomes possible to measure the plausible effects more broadly of the weapon on communication, capability, and political will. If the weapon offers a unique capability to decision makers that enables them to more successfully communicate to their adversary their willingness to use the weapon if necessary, then at a broader conceptual level the weapon enhances the credibility of the states deterrent. It does so because it offers decision makers at the political level an increasing set of options for use in a crisis, and this flexibility is more likely to be perceived by the adversary as credible. In light of each of these inquiries it becomes possible to indicate whether the overall effect on credibility is enhanced or undermined by the new offensive weapon system. If it is the case that it enhances the credibility of the state's deterrent, then it indicates that the system itself enhances stability.

Recognizing the particular impacts of the weapon system on credibility makes it possible to then examine the impact of the system on the deterrence relationship more specifically. This paper argues that the deterrence relationship that exists between the great powers today, those actively pursuing and nearing deployment of hypersonic glide vehicles, is one characterized by a rough nuclear parity. This rough nuclear parity has created a mutually assured destruction deterrence relationship between the great powers. In this type of relationship stability is ensured so long as each party retains their assured

destruction capability. With regard to technology itself two questions of inquiry are required to examine the potential effects of a new weapon system on this relationship. Does the new weapon system enhance the assured destruction capability of each party? And does the new weapon system, undermine the ability of the other party's assured destruction capability? The first question measures the positive benefit of the weapon on assured destruction. Since the relationship is premised upon the ability to assuredly destroy one's adversary than a system that enhances this ability enhances the assured destruction capability of the state. The second question examines the potential effects the weapon might have on undermining the assured destruction capability of one's adversary. If the weapon does not measurably affect the assured destruction capability of one's adversary, then it does not de-stabilize the relationship. A mutual assured destruction relationship requires not only that one enhance their own ability to destroy their adversary, but also refrain from procuring weapons that undermine an adversary's capability. If the answers to both questions enhance the deterrence relationship between the parties involved, then it is plausible the weapon system has a positive benefit on stability.

In addition to the deterrence relationship, it is important to understand the impact of offensive weapons on stability, more specifically arms race and crisis stability. Both of these concepts were created to explicitly examine the effect of technology on stability. They provide two good measures that will help indicate the overall effect of the weapon on the strategic relationship. Arms race and crisis stability provide two explicit questions of inquiry. First, does the weapon undermine the retaliatory threat from one's adversary, such that it may prompt an arms race? The second question asks: in a crisis does the

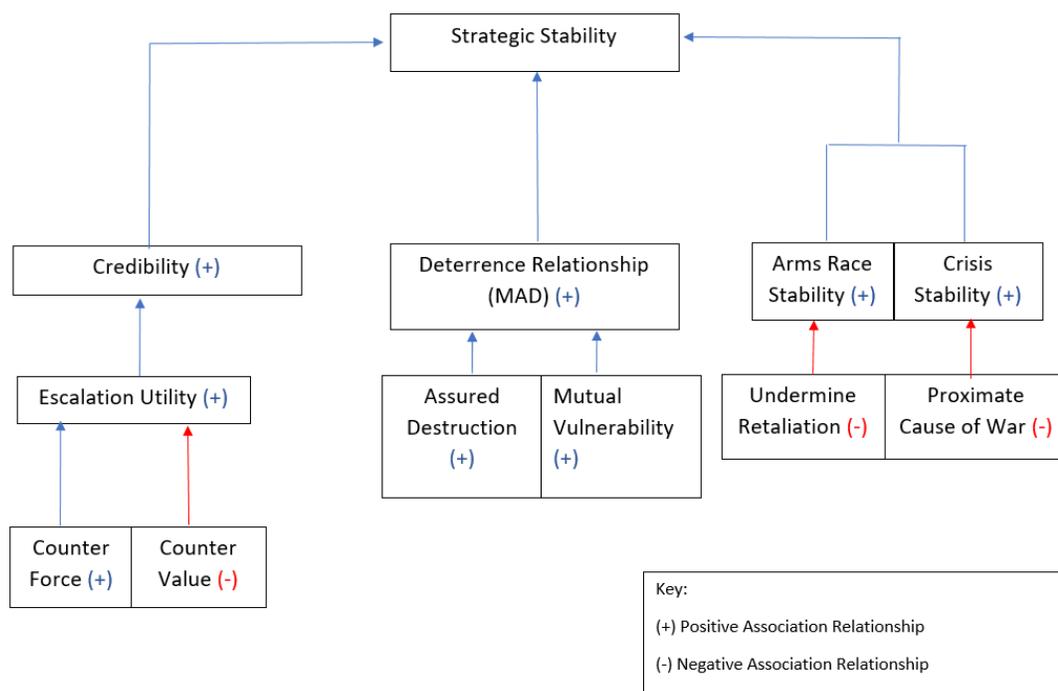
nature of the weapon incentivize its use, and thus incentivize escalation into war? If the answer to the first question is no, then a weapon undermines stability. If the answer to the second question is yes, then the weapon undermines stability. Ultimately, weapons have different effects at different levels, such that a weapon could stabilize a relationship outside a crisis, and de-stabilize inside a crisis. These two lenses offer a unique tool to understand the effects of the weapon on stability.

Having examined the offensive system under all these different lenses, a final calculation can be made that will indicate the plausible effects of a weapon system on strategic stability. Each part, credibility, deterrence, and arms race and crisis stability, provide the tools necessary to answer the question: what are the effects of hypersonic glide vehicles on strategic stability?

It is difficult to measure the specific weights corresponding to each of the three measures. Inevitably, the best indication will be arrived at by examining the weapon on balance in light of all the information discovered. If the balance is stabilizing, then arms control is not warranted, nor likely. If the balance is de-stabilizing, control would be recommended. In any case this chapter set out to unearth the concepts of the past, which are necessary to create the most comprehensive theory possible. It began by laying out the development of deterrence studies, which created the concepts necessary to answer this study's question. It then defined, delineated, and provided the historical context surrounding each of the relevant concepts. This enabled the chapter to create its own theoretical model to examine the plausible effects of technology on strategic stability. In doing so it provides a comprehensive framework to understand the effects of technology on strategic stability. Strategic stability represents the goal of modern strategic

deterrence, because a stable relationship is the one least likely to devolve into war. Stability between the three great powers today is premised on MAD. Credibility is the method by which states convince their adversaries of their assured destruction capability-communicating to them their ability and willingness to go through on their MAD threats in a crisis. The strategic designations and purposes of a weapon inform the capability and will related to a credible deterrent. Technology determines the strategic purpose of a weapon, which then affects its impact on credibility, that ultimately influences strategic stability. This theoretical framework analyzes the comprehensive nature of deterrence so that the most plausible effects of a weapon can be unearthed and comprehended.

Figure 2



Chapter 2: Strategic Stability and Technological Implications in the Past

The theoretical matrix described in the first chapter will be tested historically, to validate its inquiry and explanatory power. Validating the theory offers good evidence to suggest its utility as a theoretical model that explains the effects of offensive weapons systems on strategic stability. This chapter will conduct a case study on multiple independently targetable re-entry vehicles (MIRVs), to explain the effects of the MIRV system on stability, and reveal why contrary to arms controllers at the time, MIRVs were not de-stabilizing but rather stabilizing. To do this the section will unfold in three phases. First, it will provide a brief history of the strategic interactions between the superpowers during the Cold War. This section provides the background necessary to conduct a case study of MIRV, and also lays out the historic arguments from arms controllers against the adoption of MIRV. Second, this section will examine MIRVs under the auspices of the theoretical matrix to test if arms controllers were correct in declaring MIRVs to be de-stabilizing. Third, this section will attempt to explain the inconsistencies between historic arms controllers and its own study of MIRV, shedding light on how particular conceptions of stability impact calls for control or adoption of particular weapons systems. If it can properly assess, and explain the history of MIRVs then there is good reason to suggest the theory's utility when it comes to the near term strategic effects of hypersonic glide vehicles.

Historical Context

The concern of how weapons systems impact stability is born out of the superpower competition between the United States and Soviet Union's arms race during the Cold War. By the early 1950's the United States and the Soviet Union began missile

development programs in the pursuit of intercontinental ballistic missiles.⁹⁴ In 1957, the Soviet Union demonstrated its intercontinental capability by launching Sputnik into space.⁹⁵ At this point the Soviet Union had the leading edge, into the early 1960's the United States had perceived of a missile gap with the Soviet Union and the corresponding implications of their deployment on strategic stability.⁹⁶ By the late 1960's, the Soviet Union retained a lead in numbers of deployed ICBMs, with typically higher throw-weights than their American counterparts.⁹⁷ In response to an increasing Soviet edge in missile technology the United States began the research and testing of multiple individually targetable re-entry vehicles (MIRVs), to offset the Soviet quantitative and qualitative advantage in ballistic missiles and throw weight.⁹⁸ A MIRV is an ICBM which carries multiple warheads, each of which is independently targetable. It was designed to strike multiple installations, or targets, utilizing one launch vehicle, increasing the destructive capability of ICBMs.

The development of MIRVs and other strategic technologies in the mid-1960s birthed the first major arms control studies from the academic community, who were concerned that the development of MIRV would de-stabilize the strategic relationship between the superpowers, making war more likely. Inevitably, as is typically the case

⁹⁴ Between 1953-1960, nuclear technology progressed from “atomic arsenals, propeller driven aircraft, and medium range jet-bombers to long range jet bombers and ballistic missiles capable of carrying thermonuclear bombs”. Kahan, Jerome. “Security in the Nuclear Age”. Pg 26-27. ICBMs also required the development of thermonuclear weapons, which were lighter than their atomic counterparts. Chan, Melissa. “What is the difference between an Hydrogen Bomb and an Atomic Bomb?”. Time. September 22nd, 2017. <http://time.com/4954082/hydrogen-bomb-atomic-bomb/>.

⁹⁵Editors. “Sputnik | Satellites.” Encyclopedia Britannica. <https://www.britannica.com/technology/Sputnik>.

⁹⁶ By 1961 “fears of a possible missile gap had been put to rest”. Kahan, Jerome. “Security in the Nuclear Age”. Pg. 35-78. The fears of the impending missile gap encouraged the United States to rapidly expand its missile deployment.

⁹⁷ Kahan, Jerome. “Security in the Nuclear Age”. Pg. 187. By the end of SALT I the USSR retained 1,618 nuclear tipped ICBMS and 950 SLBMS to the United States’ 1,054 ICBMs and 710 SLBMs.

⁹⁸ *ibid.*, Pg. 180

within the academic world consensus is never reached, however, interestingly, the majority of literature from the time perceived MIRV to be de-stabilizing and in need of control, in the form of bilateral arms control.⁹⁹ Technological developments during this time set the foundations for the first set of major arms control negotiations between the United States and Soviet Union-i.e. SALT I. In light of growing pressure to set the boundaries of the relationship and investigate what each party desired vis-à-vis strategic stability, the United States, in concert with the Soviet Union began the Strategic Arms Limitation Talks (SALT I) in 1969.¹⁰⁰

During the second round of negotiations the question of controlling offensive arms, specifically MIRVs, came up between the United States and Soviet Union.¹⁰¹ Due to the technical characteristics of MIRVs, they required non-national means of verification.¹⁰² During the second round the United States proposed a MIRV ban with on-site verification.¹⁰³ Academics, such as Jerome Kahan, and others have argued the United States introduced this proposal knowing full well at the time that it was “certain to be rejected”, in light of Soviet unwillingness to allow for on-site verification.¹⁰⁴ After all, it was still an open debate between the civilian and military establishments within the United States concerning the deployment of MIRVs and their effect on strategic stability,

⁹⁹ Kahan, Jerome. “Security in the Nuclear Age”. Sartori, Leo. “The Myth of MIRV”. *Survival*. 1969. 11:12, 382-390. United States. Congress. Senate. Committee on Foreign Relations. Subcommittee on Arms Control, International Law, and Organization. ABM, MIRV, SALT and the Nuclear Arms Race. Hearings, Ninety-First Congress, Second Session. United States: 1970.

¹⁰⁰ Kahan, Jerome. “Security in the Nuclear Age”. Pg. 177

¹⁰¹ *ibid.*, Pg. 180-181

¹⁰² *ibid.*, Pg. 181

¹⁰³ *ibid.*, Pg. 181. Contemporary national intelligence assets were incapable of knowing whether an ICBM or other ballistic missile was MIRVed or not. This meant that the only means for verification was on-site, something which the Soviet Union was fully unwilling to agree to.

¹⁰⁴ *ibid.*, Pg. 181

such that an agreement to control MIRVs was highly unlikely.¹⁰⁵ As it turned out the technical and strategic issues surrounding MIRV at the time made it so both parties dropped the question of banning MIRVs.¹⁰⁶ After seven rounds of negotiation and almost three full years, the parties signed two agreements; the *Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics On Certain Measures With Respect To The Limitation of Strategic Offensive Arms (SALT I)*, and the *Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems*.¹⁰⁷ The interim agreement on limiting offensive weapons limited ICBMs to existing levels, capped the ceiling on SLBMs, and allowed for the replacement of older ICBMs with SLBMs.¹⁰⁸

By the end of the SALT I negotiations a rough strategic balance had been set; one which allowed for the development and implementation of MIRVs. The interim agreement on limitation concerning offensive weapons was to last five years, and held the promise for the further exploration of limits on offensive arms.¹⁰⁹ Over the next few years the United States began MIRVing their ICBMs and SLBMs to compensate for the quantitative and qualitative edge the Soviets held in ballistic missile launchers and throw-weight in the aftermath of SALT I.¹¹⁰ Eventually, arms control negotiations continued

¹⁰⁵ *ibid.*, Pg. 180-181. The military establishment argued that MIRVs were a necessary to offset Soviet numerical superiority. Civilian professionals on the other hand argued that MIRVs were de-stabilizing counter-force weapons.

¹⁰⁶ *ibid.*, Pg. 181

¹⁰⁷ “Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics On Certain Measures With Respect To The Limitation of Strategic Offensive Arms (SALT I)”. U.S. Department of State. Signed in Moscow on May 26th, 1972. <https://www.state.gov/t/isn/4795.htm>. “Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems”. U.S. Department of State. Signed in Moscow on May 26th, 1972. <https://www.state.gov/t/isn/trty/16332.htm>.

¹⁰⁸ *ibid.*

¹⁰⁹ *ibid.*

¹¹⁰ Kahan, Jerome. “Security in the Nuclear Age”. Pg. 187

between the two parties, with the signing of the Vladivostok accords in November 1974, which agreed in principle to the limitation of MIRVed missiles.¹¹¹ In the late 1970's the USSR and United States entered negotiations on SALT II, which although unratified by the United States was nevertheless adhered to.¹¹²

SALT II limited the number of MIRV launchers to 1,320.¹¹³ Hardly controlling them, but rather setting an upper boundary on the strategic relationship, while reaping the benefits of controlling costs. In the aftermath of SALT I, the Vladivostok accords, and SALT II, the strategic balance was stable, both sides retaining more than enough survivable strategic forces for a second strike, thus assuring the stability associated with MAD. MIRVs were adopted and implemented on mass, to over 1,300 weapons. By time MIRV had reached that many missiles the strategic purpose of balancing the Soviet quantitative edge in missiles had been achieved.¹¹⁴

The remainder of the Cold War largely went off without a hitch, and no new crises even approached the ones faced in 1961 or 1962; such that looking back historically it seems evident that MIRVs did not de-stabilize the strategic relationship, as so many academics suggested it would.¹¹⁵ At its base for a technology to truly de-

¹¹¹ "Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitations of Strategic Offensive Arms (SALT II). Signed in Vienna on June 18th, 1979. <https://www.state.gov/t/isn/5195.htm>. While never ratified the United States stood by the limits proposed in the treaty.

¹¹² Although unratified, "in 1980, President Carter announced the United States would comply with the provisions of the Treaty as long as the Soviet Union reciprocated. Brezhnev made a similar statement regarding Soviet intentions". "Strategic Arms Limitation Talks (SALT II)."

¹¹³ "Strategic Arms Limitation Talks (SALT II)." SALT II remained unratified largely due to political posturing around the Soviet invasion of Afghanistan.

¹¹⁴ There strategic purpose was to increase the destructive capability of American ballistic missiles. Their strategic objectives were thus fulfilled at such as high ceiling as was afforded by the Vladivostok Accords and SALT II.

¹¹⁵ The most unstable period during the Cold War was the early 1960's. The Berlin Crisis of 1961 and the Cuban Missile Crisis of 1962 brought the world the closest it has been to nuclear war. It is no accident that

stabilize a relationship it has to significantly threaten an opponents deterrent to such a degree that they begin doubting their retaliatory capability. This would offer incentives to shoot first- de-stabilizing the system. If anything SALT I and SALT II laid the strategic foundations for stability so high, that both sides were fully re-assured of their ability to retaliate. Moving forward, it will become interesting to examine the historic arguments concerning the perceived impacts of MIRVs by the academic community on the stabilizing and de-stabilizing effects of this technological developments. The goal is to illustrate the previously developed theory to better explain why MIRVs were not controlled during the Cold War.

Arms Control During this Period

The technological development and eventual deployment of MIRV systems in the early 1970's became one of the first real challenges for the newfound arms control community.¹¹⁶ Strategically speaking, MIRVs were a direct reaction to the Soviet quantitative and qualitative edge in ICBMs, and SLBMs.¹¹⁷ At the strategic level attaching multiple warheads to a single bus offset Soviet throw weight and provided military planners the increased ability to strike the Soviet ICBM fields in a counterforce attack. For example, one MIRVed Minuteman III could target three separate military installations, prohibiting the Soviet Union from taking advantage of their lead in total missiles.¹¹⁸ Offsetting the Soviet quantitative and throw weight advantages, was perceived to bring the United States closer to actual parity with the Soviet Union- in the

this occurred as the Soviet Union shifted from an inferior to equal relationship- strategically- with the United States.

¹¹⁶ Antiballistic Missiles were the other technological challenge to strategic stability at the time.

¹¹⁷ Kahan, Jerome. "Security in the Nuclear Age".

¹¹⁸ "Minuteman III."

aftermath of SALT I. For the military community, similar to the academic community, stability was directly related to parity and MAD, so that on their side it seemed the adoption of MIRV was wholly in line with ensuring increased stability.¹¹⁹

By contrast the nascent academic arms control community almost totally perceived of these systems as de-stabilizing. The arms control community argued that MIRV systems were specifically designed as counter-force weapons.¹²⁰ Counter-force at this period was understood by the arms control community as de-stabilizing because of its relationship to nuclear warfighting.¹²¹ For them, weapons not designed for a second-strike capacity, and not designed for retaliatory purposes, were more likely to convince states that a nuclear war may be fought and won, rather than purely deterred.¹²² Counter-force weapons, like MIRV, de-stabilized the relationship because it offered incentives in a crisis to shoot first, increasing the likelihood in a crisis, of accidental or purposeful escalation up the nuclear ladder.¹²³ If nuclear deterrence was about the absolute avoidance of nuclear war, then weapon systems designed specifically to shoot first and target counter-force targets were inherently de-stabilizing. The adoption of these technologies and postures would prompt one's adversaries to believe that you will shoot first, thus inducing them to shoot first. Thus to the arms control community, counter-force technologies, such as MIRVed missiles, were inherently de-stabilizing. They

¹¹⁹ Gray, "Strategic Stability Reconsidered."

¹²⁰ Sartori, "The Myth of Mirv." and *ABM, MIRV, SALT and the Nuclear Arms Race. Hearings, Ninety-First Congress, Second Session.*

¹²¹ *ibid.*, Pg. 384

¹²² *ibid.*

¹²³ *ibid.*

further argued that the United States even without this technology still retained its ability to retaliate and ensure the basic principle of MAD and strategic stability.

Despite these arguments MIRVs were not controlled in any real sense, and the arms control community and their understanding of stability suffered its first loss. The question remains, however, why in light of the arguments proffered by arms controllers did the US, and Soviet Union refuse to control MIRVs? The interplay of this thesis' comprehensive theoretical framework with MIRVs will illustrate why control never occurred and in so doing it will also illustrate its superiority in conceptualizing and explaining the effects of real-world technological innovation on strategic stability, offering evidence to its utility to understand modern technological developments and their potential impacts on strategic stability.

Explaining the Stability of MIRVs

In light of the context provided it is now possible to test MIRVs with the theory itself, to see if it provides a better explanatory framework for the effects of MIRV and their historic adoption by states. It will test MIRVs against the measures of credibility, deterrence, and arms race and crisis stability to unearth the overall effects of this technology on strategic stability. Doing so will make it evident why the arms controllers misperceived the effects of MIRV on strategic stability. Systematic examination will reveal the impacts of MIRV on stability. The theory proceeds to examine the MIRV system first with a study of its impacts on credibility, then a study of its impacts on the deterrence relationship more broadly, and finally with a study of its impact on arms race and crisis stability more specifically.

MIRVs and their Impacts on Credibility

With regard to credibility the theory asks this simple question. What impact does the new offensive weapon system have on credibility?

To answer question we must ask ourselves, are MIRVs designed and designated primarily as counter-force or counter-value, and what were these impacts on credibility? MIRVs were designed explicitly by the American military as unique counter-force weapon to offset the Soviet quantitative and qualitative missile advantages by targeting multiple soviet missile silos with a single ICBM. MIRVed counter-force weapons become stabilizing, because they unlike their counter-value siblings, allow a state the possibility to escalate to de-escalate. A weapon designated as counter-value cannot strike before the relative end of a conflict, as the destruction of counter-value targets leaves no incentives for restraint from the other party. Thus as a counter-force designated system, MIRV missiles offered their states the ability to escalate against military targets in the hope that resolve could be demonstrated and a general nuclear war averted.

Knowing this we must now inquire of MIRVs; do they have any utility in escalation and how would these effects impact credibility? Escalate to de-escalate gained a lot of traction throughout the Cold War. A generally stable relationship might in a crisis devolve into direct conflict. But even at this stage controlled reprisal offers both parties a series of fire-breaks to re-evaluate their desires in light of the increasingly believable fall into a general nuclear war. Limits on human rationality make it possible that a miscalculation could create a crisis and lead to direct conflict; however, the utilization of controlled reprisal makes it possible to clearly demonstrate the risks of moving forward, allowing the parties to stop and evaluate what the consequences are of further escalation.

MIRV systems at the time offered unique tools to conduct controlled reprisal. Their technological capabilities, both targetable and multiple, meant that they could be utilized to send a direct message to areas that a state wished to send. Such that it would be theoretically possible to launch a single MIRVed missile taking out three military installations, demonstrating their capabilities moving forward if re-evaluation does not occur. SLBMs on the other hand largely remain in reserve, due to their utility as counter-value weapons; there is little utility for military planners in wasting what at the time was the most survivable resource for second strike attacks on escalation attacks. In this estimation as well then, MIRVed missiles should again be perceived as stabilizing because they offer decision makers increased flexibility and options allowing them to respond to a crisis without necessarily destroying cities. To target a Soviet city would escalate a limited war to a general war, and bring with it the corresponding destruction of American society.

In light of the technical capabilities of the weapon it is now possible to ask this question of MIRVs. What were the impacts of the weapon on communication, capability, and political will more broadly? As a technological system MIRVs first interact with capability, as they directly affected the capability of the United States and eventually Soviet Union's deterrent writ large. MIRVs offer states a uniquely capable weapons system, one that can utilize a single launcher to direct multiple warheads at multiple targets. For the United States it offered them the ability to offset the Soviet missile edge in numbers and throw weight, and furthermore provided a unique counter-force weapon that could target multiple installations at one time. This capability brought with it a closer nuclear parity between the two parties.

Furthermore, MIRVs communicated to the Soviet Union, on behalf of the United States, their willingness and ability to escalate if necessary, demonstrating the U.S. commitment to follow through on its deterrent threat. The flexibility afforded by MIRVs gives decision makers new strategic options to escalate to de-escalate to de-escalate that they did not have before MIRVs. Similarly, this provided political actors with the capability to escalate as necessary in response to Soviet aggression giving them an increased option set for escalation that would not have existed without these missiles. In so doing it bolstered political will by providing a calibrated response to escalation. Without MIRVs political actors in the United States would have stood at an increasing dis-advantage with the Soviet Union in the strategic realm, which would have created incentives for the Soviet Union to believe that they held the strategic initiative. MIRVs remedied this issue by providing the necessary capability to give political actors the scope of options necessary to respond to Soviet aggression and escalate as they saw fit. It is not hyperbole to suggest that without MIRVs U.S. war planners would have been increasingly limited in their strategic response options. UnMIRVed, the United States would have to ask itself whether it would use up precious ICBM launcher resources to escalate and retain control of the escalation ladder.

Finally, with all the previous information gathered the analysis can make a judgment concerning the question: does the weapon enhance or decrease the actor's credibility? Ultimately, the demonstration and communication of MIRV capabilities to the Soviet Union created a more credible deterrent, by creating the necessary systems for the United States to escalate with Soviet Union in the event of a crisis. In total then,

MIRVs increased the credibility of the U.S. deterrent into the 1970s and beyond; which laid the foundations for strategic stability throughout the rest of the Cold War.

MIRVs and their Impacts on the Deterrence Relationship

Having come to an analysis on the impact of MIRV on credibility, it is possible now to move into the broader implications on the deterrence relationship writ large, in particular two questions must be answered. First we must inquire: do MIRVs enhance the assured destruction capability of each party? In so far as MAD itself is concerned, as was demonstrated above, MIRVs posed no threat to the Soviet Union's ability for assured destruction of the United States. Stability is not ensured or threatened innately by offensive weapons systems at all, unless they are so potent as to change the strategic relationship from parity to supremacy. It would be this change in the relationship, which would be most stabilizing. Increased mutual vulnerability and parity, afforded by MIRVs capabilities offer to further stabilize the relationship.

The second question that must be answered is: did MIRVs undermine the ability of the other party's assured destruction capability? Strategic stability is tied to MAD, such that for a weapon to de-stabilize the relationship it must undermine the credible retaliatory capability of an adversarial party. MIRVs lacked the capability to sufficiently threaten either states assured second strike during the Cold War. Considering the number of weapons involved and the force structures at play, it is highly dubious to suggest that MIRVs undermined the retaliatory capability of either party. Moreover, they offered both parties increased assured destruction. In both cases then MIRVs positively interacted with the overarching deterrence relationship enhancing the capability of both for assured destruction, which enhanced stability.

MIRVs and their Impacts on Arms Race and Crisis Stability

Having uncovered the effects of MIRVs on credibility and the deterrence relationship we can turn to their affects on arms race and crisis stability. With regard to arms race stability we must ask this question: did MIRVs undermine the retaliatory threat from one's adversary? Arms race stability requires that a state does not pursue the development of technological weapons systems that undermine their adversary's ability to retaliate. It is intimately linked to the overall appreciation that systems that undermine retaliation threaten a strategic stability that is premised largely upon MAD. In this regard MIRVs do not, and did not at the time undermine the Soviet Union's ability to retaliate against the United States and follow through on their deterrent. By the late 1960s the Soviet Union had developed 62 SSBNs, which would be equipped by the 1970s with 950 SLBMs.¹²⁴ The inability to sufficiently detect and track SSBNs, meant that these weapons platforms formed the backbone of the Soviet Union's retaliatory capability.¹²⁵ These SSBNs provided the main leg of Soviet and American retaliatory capability, and MIRVs are simply incapable of destroying SSBNs.¹²⁶ Because of this the Soviet Union did not perceive MIRV systems as de-stabilizing and thus remained to negotiate MIRVs during SALT I when it was brought forward by the United States. Despite the fact that

¹²⁴ *ibid.*

¹²⁵ Fergusson, James. "Canada and Ballistic Missile Defence". Pg. 27

¹²⁶ It might be argued MIRVs could hit SSBNs that were docked but the Soviet Union throughout the Cold War kept 'x' SSBNs on patrol in the waters. Such that the numbers on patrol were more than able to carry out a retaliatory attack. Moreover, the unbelievably high ceilings on strategic delivery vehicles after SALT II, meant that launch on warning postures could easily mitigate any potential counterforce value for a strategic surprise attack.

the Soviet Union did not have MIRVs during SALT I they saw no need to attempt to control their implementation by the United States.¹²⁷

Arms race stability provides one lens, while crisis stability provides another. Now the question must be asked: do MIRVs incentivize their use in a crisis, and thus increase the likelihood of conflict? The concept of crisis stability asks, what are the effects of technology on a crisis. If those effects increase the incentives to go to war first, then the systems involved are theoretically de-stabilizing. MIRVs due to their primary designation as a counter-force weapon indicates that they would be utilized in a first strike. Landlocked MIRVed ICBMs, are vulnerable to an enemy's first strike, incentivizing commanders toward their use. This reflects the use or lose it problem typically associated with first strike weapons. Such that military planners would use them sooner rather than later, increasing the likelihood of war. Thus in specific regard to crisis stability MIRVs are de-stabilizing, because they are increasing usable in a crisis, and risk escalation.

MIRVs Overall Impact on Strategic Stability

In light of the inquiry with the theory above it is now finally possible to examine MIRVs comprehensively and argue that their overall impact as weapons during the Cold War was stabilizing. The historic record bears out the realization that MIRVs were not de-stabilizing to the strategic stability of the Soviet Union and U.S. Their development and later control at 1,320 MIRVed missiles for each power solidified their place in the strategic relationship. It is obvious to those looking back that the aftermath of the SALT I

¹²⁷ Some might argue that MIRVs by this account are neither stabilizing or de-stabilizing; but that would indicate that the measure of stability never runs both ways but rather only concerns itself with de-stability i.e. if the evidence that adoption of MIRVs was not stabilizing then are any adopted weapons systems stabilizing?

agreements and Vladivostok accords were in fact the most stable during the course of the Cold War. The era of détente announced by the SALT I agreements is evidence of just how stable the relationship had become between the Soviet Union and United States. And this, is all in light of the fact that MIRVs were fully adopted for strategic purposes, and were in fact, as mentioned above, directed towards creating parity, not upsetting the strategic balance. Ultimately, MIRVs provide a useful case study for the utility of the technological theory provided to understand the comprehensive effects of new technologies on strategic stability. The theory clearly demonstrates that in total examination that MIRVs were in fact far from de-stabilizing and were indeed more likely stabilizing. As it came out MIRVs can only be conceived as de-stabilizing in one regard; crisis stability. In the other five regards they stabilized the relationship. Moreover, at the upper end of the conceptual ladder, MIRVs more generally speaking created increased credibility, while bolstering the associated assured destruction threats associated with MAD. The theory clearly illustrates not only why these weapons were in and of themselves stabilizing, but also explains why the Soviet and Americans respectively did not attempt to control them in any meaningful way.

Why the Inconsistency?

The question remains then, why did arms controllers of the past misunderstand the effects of MIRVs on the strategic relationship to such a degree as to label the weapons de-stabilizing and in need of control. It seems most likely that the young study of arms control in the 1960s over-emphasized the relationship of weapons to counter-force, and counter-value to such a degree as to disregard the series of other variables involved in a complex strategic relationship between rivals. It seems plausible to suggest

that arms controllers became blinded to the goal of deterrence in the complex relationship between the United States and Soviet Union. It was their belief it seems that nuclear deterrence should be directed toward the avoidance of any nuclear contact between states, rather than the avoidance of a general nuclear exchange. The reason this matters is because the United States' deterrent in the Cold War had to deter aggression not only against itself but against its NATO allies. By time the Soviet Union had achieved parity, the credibility of immediate escalation to general nuclear war in response to Soviet aggression against Western Europe was incredible. No American politician would sacrifice New York city over the conventional invasion of Berlin by Soviet forces; to do so would be to sacrifice millions of your own citizens for foreigners. Thus a credible deterrent in Europe required the United States to create a war fighting and war winning doctrine, and enable them to slide up and down the escalation ladder to convince the Soviet Union of the credibility of their deterrent. Indeed, it becomes much more plausible that if a real conflict broke out in Europe and the United States had skin in the game then the risks to both parties for escalation into a general war increased. It was the unwillingness of arms controllers to recognize the changing strategic balance, which made war fighting and escalation central to the American deterrent. Moreover, it was this realization that provides evidence, that by the late 1960s that the goal of the United States' deterrent was avoiding a general nuclear exchange more so than a limited one. Misunderstanding the credibility problems associated with doctrines such as Massive Retaliation meant that arms controllers willfully disregarded the credibility problems associated with such a doctrine, and failed to realize that a credible deterrent in the era of

strategic nuclear parity required the full development of counter-force weapons to create a credible deterrent in the eyes of their adversary.

This chapter has conducted a case study of the effect of MIRV on strategic stability during the Cold War. Contrary to the opinion of historic arms controller's, history has borne out the recognition that these weapons did not de-stabilize the nuclear relationship between the Soviet Union and United States. The MIRV provides good evidence that the theory is capable of understanding the effects of technology upon strategic relationships and can clearly illustrate at each level why a system is either stabilizing or not. There is good reason then to suggest the utility of the theory to describe the effects of new technologies on strategic stability, such as the hypersonic glide vehicle. If it has worked to explain the case study, then it should equally work to help explain the potential affects of these vehicles on a new strategic relationship.

Chapter 3: Implications for Strategic Stability in the Hyperglide Era

Having demonstrated the utility of this paper's theoretical framework to explain the impacts of MIRV on strategic stability during the Cold War, this chapter will endeavour to examine the potential implications of hypersonic glide vehicles on the strategic relationships between the three great powers pursuing them today. The chapter will proceed in two phases. First it will provide a brief examination of the developmental history of the hyperglide, to give a background to where this technology came from and why it was developed in the first place; it will include a brief discussion on the strategic statements of those developing them as well. It will also provide the technical capabilities of the vehicles. Both strategic statements and technical capabilities will inform the likely designations and impacts of this technology vis-à-vis strategic stability in the near future. The second phase will examine the hypersonic glide vehicle utilizing the theoretical matrix to unearth the plausible effects of hypersonic glide vehicles on strategic stability into the near future. In light of this, the answer to this study's question: what are the effects of hypersonic glide vehicles on strategic stability will finally be revealed.

Much has been made over the past decade about the potential strategic implications of these weapons, but all accounts lack a comprehensive study of the impact of these systems upon strategic stability. Many call for the control, or abandonment of these new technologies without first comprehensively examining whether they are stabilizing or de-stabilizing. Luckily, the Cold War, and its lessons have provided the tools necessary to examine the plausible effects of this new technology upon strategic stability. The measurement of hyperglide vehicles against the theoretical precepts of deterrence, credibility and stability, in light of the historical case of MIRV, make it

possible to indicate conceptually whether these systems will ultimately stabilize or de-stabilize the deterrence relationships between the great powers. By measuring the technical capabilities and nascent doctrinal statements against the concepts of deterrence it becomes possible to indicate their strategic implications moving forward and offer advice to policy makers about whether these systems should be adopted and implemented, or controlled and abandoned.

Historical and Technological

The development of hypersonic glide vehicles by the United States of America, the Russian Federation, and China are the first major offensive technological strategic developments in nuclear and conventional arms between the three in the past 30 years, which has either the potential to stabilize or de-stabilize their deterrence relationships. During the Cold War, the management of strategic stability was the primary concern of deterrence studies.¹²⁸ Technologies, strategic posture, and doctrine are the inputs into a strategic relationship that can undermine or enhance the stability of a deterrence relationship. If technologies, postures, or doctrines were seen as stabilizing they were readily adopted by states, however, if they were perceived as de-stabilizing they would be systematically controlled, via the utilization of arms controls, which set the boundaries on the strategic relationship between great powers.¹²⁹

Like all weapons development programs, they do not occur in a vacuum, but rather are attempts by military, scientific, and industrial partners to solve strategic

¹²⁸ Gray, Colin S. "Strategic Stability Reconsidered." *Daedalus* 109, no. 4 (1980): 135-54. Pg. 135

¹²⁹ Fergusson, James G. "Canada and Ballistic Missile Defence 1954-2009: Déjà Vu All Over Again". UBC Press. 2010. Pg. 27-72

problems. The current development of hypersonic weapons, and in specific hypersonic-glide vehicles traces its lineage back to 2003, with U.S. attempts to develop a Conventional Prompt Global Strike (CPGS) capacity.¹³⁰ CGPS was developed in the aftermath of 9/11, and it sought to provide the United States the ability to strike targets across the globe with fast, long-range non-nuclear weapons.¹³¹ Originally, much of the CGPS debate focused around the utilization of ICBMs with non-nuclear warheads; however Congress refused to fund further research into CGPS on the ballistic front because China and Russia had expressed fears of warhead indistinguishability- the concern that states will not be able to understand whether a launched missile carries a nuclear or conventional warhead.¹³² Having lost congressional approval for the utilization of ICBMs for CGPS, the Bush administration turned to the creation of a new weapon system that would provide a conventional, fast, and accurate missile system, global in nature, while allaying fears of missile indistinguishability.¹³³ The flight path of hypersonic glide vehicles is distinct enough to be recognized as to be different from ICBMs, and as such the U.S. at the time believed they could be pursued without destabilizing the strategic relationship between the United States, Russia, and China. Moreover, at the time current obligations by the United States to the Intermediate Nuclear Forces treaty and the Strategic Arms Reduction Treaty (START) made the utilization of ICBMs for this purpose unviable.¹³⁴ It would be strategically questionable to utilize precious strategic launchers, limited by the START treaty, for conventional attacks.

¹³⁰ Acton, James M. (2015) Hypersonic Boost-Glide Weapons, *Science & Global Security*, 23:3, 191-219. Pg. 192

¹³¹ Acton, "Hypersonic Boost-Glide Weapons". Pg. 192

¹³² Ekmektsioglou, Eleni. "Hypersonic weapons and escalation control in East Asia." *Strategic Studies Quarterly* 9, no. 2 (2015): pg.

¹³³ *ibid.*, Pg. 47

¹³⁴ *ibid.*, Pg. 45

Interestingly, over the course of the first decade of the 21st century the justification for the development of hypersonic weapons shifted from a counter-terror role to a anti-access/area denial purpose (A2/AD).¹³⁵ Indeed, the second nuclear age has been characterized increasingly not only of the need to deter peers but also rogue states, such as Iran, and North Korea; the adoption of these systems would provide an option to deter rogue actors with immediate punishment- roughly one hour- and provided the ability to decrease U.S. reliance on forward operating bases.¹³⁶ Since then, all three great powers, and certain allies associated with them have begun developing and testing hypersonic glide weapons capabilities.

By 2016 the Russians had indicated their ability to hit a target with a hyperglide within a 10,000 km radius at speeds of roughly 12,300 km/h.¹³⁷ In March of 2018, the Russian President Vladimir Putin oversaw the graphic demonstration of his new missile programs, one which included a visual demonstration of the Avangard hypersonic glide missile, to the chagrin of the U.S and her allied partners. The Avangard, codenamed Yu-71 and Yu-74, hyperglide system has been designed to be carried by SS-19 stiletto, SS-X-31, and SS-X-30 intercontinental ballistic missiles.¹³⁸ The Russians have declared that they will deploy hypersonics as early as 2019 at Dombarovsky missile base in central Russia.¹³⁹

¹³⁵ *ibid.*, Pg. 45

¹³⁶ *ibid.*, Pg. 45 ----time and cite.

¹³⁷ Kremeyer, "Hypersonics Changing the World."

¹³⁸ "Avangard Hypersonic Glide Vehicle". Missile Defence Advocacy Agency.

<http://missiledefenseadvocacy.org/missile-threat-and-proliferation/missile-proliferation/russia/avangard-hypersonic-glide-vehicle/>

¹³⁹ Akulov Andrei. "Russia Deploys Its Avangard Glide Vehicle – the Unmatched Leader in Hypersonic Technology". Strategic Culture. <https://www.strategic-culture.org/news/2018/11/08/russia-deploys-avangard-glide-vehicle-unmatched-leader-hypersonic-technology.html>

As of 2016 China had successfully tested a hyperglide vehicle, codenamed the WU-14, for the seventh time.¹⁴⁰ Then in November 2017, the Chinese conducted two tests of the DF-17 medium range ballistic missile; the first missile to be equipped with a hypersonic glide vehicle designed for operational deployment. The first test saw the vehicle travel a range of 1,400 km in 11 minutes at a depressed altitude of roughly 60 km.¹⁴¹ The U.S intelligence community assess the DF-17 MRBM to possess a range between 1,800 -2,500 km, and it is expected to reach initial operational capability by 2020. The DF-17 is most likely derived from the People's Liberation Army Rocket Force's DF-16- road mobile, solid-fueled, short range ballistic missile.

Interestingly, while beginning the thrust of development into the hypersonic weapons sphere, the United States suffered some difficulties with its hyperglide vehicle project in 2011 after a failed test of the Hypersonic Technology Vehicle 2 (HTV-2) in 2011.¹⁴² The United States is currently developing a hyperglide vehicle called the Advanced Hypersonic Weapon (AHW), which is planned to be deployed by the Army in the 2020's.

While much can be made of different the strategic effects of conventional versus non-conventional forces, the reality is that strategic weapons are inextricably linked to nuclear and strategic deterrence. Modern technology has begun to blur the conceptual separation between strategic and non-strategic weapons- the latter being associated during the Cold War exclusively to nuclear weapons. While this is true, a strategic attack

¹⁴⁰ Codenames will be U.S/NATO, unless such designations do not yet exist.

¹⁴¹ "China Tests New DF-17 with Hypersonic Glide Vehicle". Missile Threat, CSIS Missile Defence Project. January 4th, 2018. <https://missilethreat.csis.org/china-tests-new-df-17-hypersonic-glide-vehicle/>

¹⁴² Malik, Tarik. "Death of DARPA's Superfast Hypersonic Glider Explained". Space.com <https://www.space.com/15388-darpa-hypersonic-glider-demise-explained.html>

is a strategic attack whether nuclear or non-nuclear; it represents conceptually an existential attack on a state. Such that it matters little to an adversary if your strategic attack is nuclear or non-nuclear, meaning the response will entail the utilization of all possible means- including nuclear weapons. This means that hyperglides are strategic weapons linked conceptually to strategic deterrence. Thus their utility is limited by the recognition that they exist at the strategic level, which itself is linked to nuclear weapons. Conceptually, hyperglides exist in the strategic realm because they are designed to attack forces deep in enemy territory and destroy national installations. Russia and China see these weapons as strategic, thus de-limiting their utility for CPGS. They have forced hyperglides into the strategic realm making them tactically unusable by the United States outside of the strategic deterrence realm. The Russian government's statements communicate them as such, which will make it nearly impossible for the United States to ever utilize them stably as a conventional prompt global strike weapon. They have been moved into the realm of strategic deterrence and their role will serve to support MAD between the great powers. Having revealed the strategic designation and implications of hypersonic glide vehicles it is now possible to examine their specific technical characteristics.

At a foundational level it is the technical aspects, which dictate the vehicles capabilities that informs its designation doctrinally and its application in a broad force network that makes up an states strategic deterrent. Technically speaking "Hypersonic glide vehicles (HGV's) are launched by rockets into near space, where they are released and fly to their targets by gliding along the upper atmosphere".¹⁴³ They travel at

¹⁴³ Speier, Richard et. al, "Hypersonic Missile Nonproliferation", Pg. xi-xii

hypersonic speeds and [at unusual] altitudes”.¹⁴⁴ Hypersonic glide vehicles are those that travel between Mach 5 and Mach 25, approximately 5,000-25,000km/h.¹⁴⁵ Moreover, these vehicles glide at peculiar altitudes, roughly 40 to 100km high, where they fly to their targets.¹⁴⁶ Finally, it must be noted that gliding along the upper atmosphere as they do, the vehicles can take advantage of air resistance and design to maneuver during the course of their flight, to avoid radar detection and ballistic missile defences.¹⁴⁷

Developmental projects and tests indicate that the range of these vehicles currently lies between 1,500km-17,000km.¹⁴⁸ The typical operational concept is that HGVs are placed on top of a ballistic missile with its accompanying warhead up through the boost phase of the ballistic missile, then detaching at the appropriate altitude to enable the vehicle to glide toward its target.¹⁴⁹ The release conditions of the HGV are driven by the intended trajectory- down-range and cross-range- which enable the vehicle to have enough initial speed to reach the target.¹⁵⁰ In broad technical discourse the HGV provides offensive advantages due to its maneuverability, which allows it to utilize mid-flight updates to attack a different target than originally planned.¹⁵¹ The unpredictability of their trajectories allows these systems to hold extremely large areas at risk through much of the flight.¹⁵² Defensively, these systems fly low enough that they cannot be targeted as yet by midcourse ballistic missile defense systems, and fly too high to be targeted by Theatre

¹⁴⁴ *ibid.*, Pg. xii

¹⁴⁵ *ibid.*, Pg. xi. For comparison the American Minuteman III missile flies at approximately Mach 23 or 24,000 km/h.

¹⁴⁶ *ibid.*, Pg. 8

¹⁴⁷ *ibid.*, Pg. 8

¹⁴⁸ Current tested ranges indicate a 10,000 km range, and the proposed range for the U.S. HTV-2 is approximately 17,000km.

¹⁴⁹ Speier, Richard H. et al. “Hypersonic Missile Nonproliferation”, Pg. 8

¹⁵⁰ *ibid.*, Pg. 8

¹⁵¹ *ibid.*, Pg. 8

¹⁵² *ibid.*, Pg. 9

High Area Altitude Defense (THAAD) systems.¹⁵³ Hyperglide vehicles at their base are new weapons systems that challenge contemporary missile defence systems, with their unique maneuverability and altitude; technically speaking, these missiles due to their unique configuration are increasingly survivable when compared to their ICBM, IRBM, SLBM, and SRBM counterparts.

Exploring the Effects of HGVs on Strategic Stability

It is now finally possible to use the theoretical matrix to predict the likely effects of hypersonic glide vehicles on strategic stability. The study will proceed first by examining the impacts of the vehicle on credibility, then on the deterrence relationship writ large, and finally, the impacts of the vehicle on arms race and crisis stability. In so doing it will discover on balance whether hypersonic glides vehicles are likely to be stabilizing or de-stabilizing on the strategic relationships between the great powers into the near future.

HGVs and their Impact on Credibility

Before we can understand the overarching impact of the weapon on credibility writ large we must first ask: are hyperglides likely to serve a counter-force or counter-value role, and how might this plausibly impact credibility? Into the near future, hypersonic glide vehicles will be primarily designated as especially useful counter-force weapons. Technological limitations, arising out of the fact that these systems are still being tested and perfected by the relative powers at play, suggests that the early utility of these weapons will be as precision strike, strategic missiles, that will be utilized to

¹⁵³ *ibid.*, Pg. 9.

reliably destroy critical infrastructure in one off attacks for the purposes of escalate to de-escalate.

It is entirely plausible that in a crisis, an adversary seeking to escalate to de-escalate would utilize one of these missile systems thanks to their increased penetrability and survivability. The utilization of a traditional ICBM for a one shot escalate to de-escalate attack risks being shot down by BMD system, and in so doing fails to send the proper escalatory message to one's adversary. Without hyperglides an adversary might be incentivized to shoot not one but three traditional ICBMs and thus send a message that does not escalate to de-escalate but rather escalates in the extreme. The ability of hyperglides to reliably strike whichever target it so chooses while frustrating BMD makes them particularly useful as counterforce weapons in the near future. As a counterforce weapon, these systems stabilize the strategic relationship because they provide the technical means for an actor to send the proper escalatory messages and put a firebreak on the conflict. Counterforce weapons, while incentivizing war actually seek to stop escalation into a general strategic exchange, and in so doing stabilize the relationship.

Their increased survivability after launch indicates to one's adversary that they cannot protect themselves, offering incentives for the party attacked to consider further aggression and the costs associated with such action. There's no strategic benefit at the moment or projected into the near and medium future for hyperglides to be utilized as counter-value weapons- it would be cheaper to build massive amounts of cheaper ICBMs and SLBMs to fulfill this role. In any case the targeting of counter-value assets is destabilizing because it removes any incentives for the other party to not respond strategically. Indeed, counter-force weapons provide the unique capability to escalate to

de-escalate and send the strategic signals necessary to one's adversary that escalation into the counter-value domain is unwanted by both parties. In this regard then hypersonic glide vehicles stabilize the strategic relationships because they make the prospect of a general war less likely.

Having unearthed the answer to that question it becomes important to ask the connected question: what is the hyperglides utility in escalation, and how might this plausibly impact credibility? Hyperglides are much better than their traditional ICBM counterparts in the realm of escalation and controlled reprisal because they are more penetrable and survivable; moreover, their maneuverability has unique impacts on the strategic decision making of an adversary, which offers unique firebreaks to the escalation ladder. What is unique about hyperglide vehicles in the escalation ladder relates directly to their speed and maneuverability. Since the hyperglide can maneuver during most of its flight, it is relatively unclear to the receiving party precisely what is being targeted.

For instance, imagine that the Russian Federation in a crisis launched an escalate to de-escalate strike against the United States, coming over the North pole. In a one off shot, prudence and patience among the American general staff should be warranted until after the missile has struck its target. For instance, a hypersonic glide vehicle coming over the north pole directed generally toward the central United States, could be targeting any series of targets; USSTRATCOM, in Omaha Nebraska, a US air base outside Minot, or even an uninhabited area in northern Manitoba. Each of these three targets sends a different deterrence message to the United States. Each of these three hypotheticals, and any series of others illustrates the utility of these systems in escalatory strikes to send

different messages. When coupled with the speed of the systems, and target indistinguishability it should induce control and command to patience. Inevitably their maneuverability means that it would be unclear until almost the last moments of flight as to what the particular response should be. In each case the response would change, because the signal and associated costs change. Striking STRATCOM is not the same in a strategic sense as striking northern Manitoba. Finally, the speeds of current hypersonic vehicles is roughly half that of current ICBMs.¹⁵⁴ This means that the average flight time of a intercontinental hypersonic vehicle is roughly 45-60 minutes as compared to the traditional ICBMs 30 minute flight time. Increased time and the inability of actors to recognize the target further induces command and control to patience. Fundamentally, the speed of the vehicles offers decision makers roughly one third to twice as much time to comprehend the best response and the likely effects that response will have on one's adversary. This induces decision makers to a better decision and offers them more time to consider the big strategic picture and the costs associated with improper retaliation and escalation.

The target necessitates the response such that a different target induces a different response, which means it would be imprudent to act before the target has been struck. The speed offers precious resources in the form of time for leadership to formulate the best response to the escalatory strike; it gives them more time to consider what their responses effect will have and thus in total examination increases the likelihood that commanders will properly perceive the costs and benefits of further aggression on both

¹⁵⁴ For comparison the American Minuteman III missile flies at approximately Mach 23 or 24,000 km/h. The Russian tests flew at approximately Mach 10, less than half the speed of a traditional ICBM.

sides, such that a general nuclear war is more avoidable than was previously the case with traditional ICBMs. In this sense, hyperglides have a unique utility on the escalatory ladder when compared to their ICBM siblings.

Recognizing their strategic implications, it is possible now to inquire of hyperglides, what their likely impact will be on the broader conceptual notions surrounding credibility. What are the plausible impacts of the weapon on communication capability, and political will? Hyperglides offer a unique capability that communicates a very real and credible threat to one's adversary. The inability to defend against these systems, due to their capabilities, offers a credible deterrent. While they have direct impacts on the capability, it is also their impact on political will that engenders the increasing credibility of one's deterrent. In regard to specifically political will, hyperglides provide instruments that are actually useable for the purposes of deterring a general nuclear war. The inability to stop them from hitting targets, and their precision as weapons gives actor's a host of viable decisions for their utilization as escalatory weapons. In this sense, their credibility is directly related to their usability. Hypersonic glide vehicles represent soon, and for the near future a weapon that is uniquely useable. In the tradition of Herman Khan, a weapons system that is unusable has no deterrence effect.¹⁵⁵ Credible deterrence requires that political actors actually be able to use them. In this sense, then hyperglides provide the necessary delivery systems to actually use one's weapons, and thus provide a credible deterrent to one's enemy. Hyperglides are flexible weapons that provide increased credibility to a state's deterrent. The positive effects of

¹⁵⁵ Khan, Herman. "On Escalation

hyperglides on credibility have a correlating positive affect on stability. Such that it can be argued in this regard that hypersonic glide vehicles are stabilizing.

HGVs and their Impact on the Deterrence Relationship

Understanding the impacts of this new technology on credibility it is now possible to examine more broadly its affects on the strategic deterrence relationship between the three great powers. Recognizing the foundational relationship between the three great powers is one of MAD, we must inquire as to the effects of hyperglides on this strategic balance. We ask hyperglides first: do hypersonic glide vehicles enhance the assured destruction capability of each party? In a general sense, hypersonic glide vehicles are stabilizing to the deterrence relationship because they enhance the assured destruction capability of the nations who hold them. The Americans already retain relatively complex BMD mid-course defences against ICBMs, and both the Chinese and Russians are investing in their own complex mid-course ballistic defence programs.¹⁵⁶ The enhanced assured destruction capability arises from the maneuverability and unusual altitudes in particular. At their core hypersonic glide vehicles are increasingly survivable when compared to older missile systems, enhancing the overall destructive effect of a states deterrent by ensuring that once launched these missiles will hit their target. The capabilities of these new missiles threaten adversaries with destruction, which lies at the heart of MAD. They make each of the states more vulnerable to attack than they would be without these systems. This increased mutual vulnerability of states to these systems ensures that each party will retain an assured destruction capability into the near future.

¹⁵⁶ “2019 Missile Defense Review.” Pg. V-XII

Having enhanced the destructive capability of each state who will hold them, the next question that has to be answered is: do hyperglides undermine the ability of the other party's assured destruction capability? Hyperglides do not and will not have the capability to undermine the assured destruction capability of any of the three great powers into the near future. The majority of these states' assured destruction capability either exist underwater-in the form of SSBNs-, or on land- in the form of mobile ICBM launchers. Whatever worries exist about their ability to take out the assured destruction capability of states, such as China must recognize that this problem can be remedied doctrinally with the adoption of a launch-on-warning posture. This indicates that they do not in a comprehensive sense undermine assured retaliatory capability of the three great powers.

Hypersonic glide vehicles enhance the assured destruction capability of states and fail to undermine an adversary's retaliatory capability. With regards to the overarching deterrence relationship that exists between the three great powers, who plan on eventually deploying these systems, it can be argued that they enhance the deterrence relationship and strategic balance of the states involved. In this regard they enhance stability, because they enhance the mutual nature of the deterrence relationship, and offered increased assured destruction. From here it becomes possible to examine the effects of hyperglides on arms race and crisis stability.

Impact on Arms Race and Crisis Stability

Turning finally to the specific impacts of hypersonic glides vehicles on arms race and crisis stability we can ask two questions. First we ask, do hypersonic glide vehicles undermine the retaliatory capability of peer-to-peer competitors? In regards to

hyperglides they do not and will not have any specific impact on the strategic retaliatory capability of actors in the near to medium future. Inevitably, they are designed to target counterforce weapons, and the cost, technical characteristics, and initial deployments, will lack the capability to threaten the major powers retaliatory capability into the near future. The Russians, Americans, and Chinese all understand that the primary retaliatory capability of their states' exist in their ICBM and SLBM assets. The Russians currently deploy 1,420 strategic nuclear warheads on a series of platforms. The Chinese currently deploy 280 strategic nuclear warheads deployed on a series of platforms. The Americans for their part currently deploy 1,328 strategic nuclear warheads on a series of platforms.

Much is made by Keir Lieber and others about the capability of a U.S. counterforce weapons in the modern era, however they disregard the particular realities that arise in a crisis.¹⁵⁷ It may be true that much of the adversarial capabilities in a general non-crisis sense could be targeted; but the size of adversarial strategic forces allow them to adopt particular strategies to offset such counter-force capabilities. It would be relatively easy to adopt in a crisis a, launch on warning posture, which would disable the American confidence of a successful pre-emptive strike.¹⁵⁸ So in this sense the U.S. counterforce capabilities in fact do not threaten the retaliatory capability of the Russian Federation and China in any real sense.

¹⁵⁷ Keir A. Lieber and Daryl G. Press. "The New Era of Counterforce: Technological Change and the Future of Nuclear Deterrence." *International Security* 41, no. 4 (2017): 9-49.

¹⁵⁸ "Launch on warning (LOW), [is a] military strategy that allows high-level commanders to launch a retaliatory nuclear-weapons strike against an opponent as soon as satellites and other warning sensors detect an incoming enemy missile". Editors. "Launch on Warning: Military Strategy". *Encyclopedia Britannica*. December 16th, 2015. <https://www.britannica.com/topic/launch-on-warning>.

In any case returning to the specific affects of hyperglides on arms race stability, they do not have any greater de-stabilizing features than traditional ICBMs. They cannot sufficiently threaten submarine targets, and into the near future their will not be enough of them to even threaten ICBM targets. In their inability to threaten the core of states' retaliatory capability it would irresponsible to suggest that they are de-stabilizing. To suggest they are de-stabilizing is to suggest that all ICBMs are de-stabilizing, which is neither true theoretically or historically speaking. In the realm of deterrence, perception matters, such that for a technology to de-stabilize a relationship it needs to be perceived as de-stabilizing a relationship. Clearly ICBMs have not been considered as such; and therefore it would be imprudent to suggest that hyperglides will be. If they mimic ICBMs as they look to be doing, they will in fact stabilize the arms race.

Having revealed their impact on arms race stability, it is now possible to ask of hyperglides this question: In a crisis does the weapon incentivize its use, and thus incentivize conflict? Their utility as a counterforce weapon, and limited deployment and associated strategic designation suggests that hyperglide vehicles would be utilized relatively early among the various strategic systems. In a crisis it is logical to suggest that there would be incentives to use the hyperglide before you lose the hyperglide. In this sense, the technology incentivizes commanders toward their use earlier in a conflict when compared to other strategic weapons. Inevitably, there are direct incentives for commanders to use these weapons. Hyperglide technology is de-stabilizing during a crisis because they provide such an easy means for use. Because of this the balance of the weapon is split, it does not de-stabilize the relationship in an arms race sense, but does so

in a crisis. So what then in a comprehensive sense is the impact of hyper glides on strategic stability overall?

Overall Impacts of an HGV on Strategic Stability

Having unearthed the plausible effects of the weapons on these different concepts we can work to understand the overall effect of hyperglide vehicles on strategic stability. Strategic stability between the great powers today is one premised upon the MAD relationship. Technologies that undermine this relationship, de-stabilize the strategic balance, generate strategic instability and thereby increase the likelihood of a general war. Hypersonic glide vehicles for the host reasons presented above do not in fact de-stabilize the relationship but rather stabilize it to an increasing degree. Looking to the theory itself it became clear that hypersonic glide vehicles are stabilizing on balance. Taking account of its strategic designation, and technological capabilities, in relation to the goals of deterrence in the modern world between the great powers, we find that hyperglides are stabilizing in all but one sense- crisis stability. The goals, and strategic designations for the system illustrate that these systems are not in fact de-stabilizing.

It is important to recognize that it is not an accident that the majority of testing and announced deployment is actually coming first out of the Russian Federation and People's Republic of China. If anything, the rapid development of this technology and other related technologies seeks to remedy the increasing disparity between the great powers since the end of the Cold War, much in the same way that MIRVs were used by the United States to remedy the perceived missile gap in the 1960's. Thus in a broader strategic sense it is unsurprising that the weaker of the three powers are leading the testing, development, and deployment of this technology. They are seeking to bring more

parity to the strategic relationship; and increase the credibility of their threats of assured destruction toward the stronger power. An increasing parity, strategically comes with it a more stable situation. Thus by this estimation, in light of history, hypersonic glide vehicles have been pursued to bring the three powers closer to parity at the strategic level. In so doing these weapons will stabilize the strategic balance, premised upon MAD, now and into the future.

Hypersonic glide vehicles at the strategic level stabilize the relationship by offering unique capabilities that provide commanders the ability to deter a general nuclear war. At the conceptual level, they increase the credibility of states' deterrents through their designation and utility as a weapons system. Finally, they both support the assured destruction of adversaries and fail to undermine one another's retaliatory capability. The current strategic balance today still belies its direct relationship to MAD. All three great powers retain the MAD capability, and thus hyperglides support of this relationship is what makes it a fundamentally stabilizing weapons system. As in the past, technologies that stabilize the strategic relationship will be adopted and implemented by states who see their strategic value.

On balance, this matrix indicates that it is unlikely the three great powers will move to control implementation of hypersonic glide vehicles. Like MIRVs, it is unlikely that these weapons will be controlled, until such a time as they have maxed out their strategic purpose and increased numbers would be a cost-drain. Inevitably, the Russians and Chinese will likely not agree to abandon a system that they perceive will hold the Americans increasingly vulnerable, especially as the United States has spent the last 30 odd years striving, knowingly or unknowingly, towards supremacy. Luckily, the United

States never achieved supremacy, and the stability of these relationships is still premised upon MAD. In any case, hyperglide vehicles will increase the strategic parity of these relationships and thus the strategic stability. Theoretically speaking, the great powers should welcome the increased parity and stability that comes along with it. It is clear by now that hypersonic glide vehicles will likely stabilize the relationships between those who shall deploy in the near future. The great powers should not attempt to control them until they have been fully developed and implemented. If stability is the aim of strategic deterrence, then these systems will do much to create a stable deterrence relationship between the three great powers well into the coming decade.

Conclusion

If one concedes the modest assumptions associated to the technological theory, then it is clear that hypersonic glide vehicles are a technology that will in all likelihood stabilize the strategic relationship between those who have them into the near future. If one concedes that the purpose of nuclear deterrence since the 1960s is based not upon avoiding and deterring a limited nuclear war per se, but rather a general nuclear exchange then it becomes increasingly obvious that hypersonic glide vehicles are stabilizing. If one concedes that no matter the current technological gap between the United States, and Russia and China that the current strategic relationship is one of MAD, and premised upon MAD, then it is clear that hypersonics are stabilizing. If one concedes that it is plausible that strategic escalation offers decision makers the ability to refocus their interests and avoid escalation into general nuclear war, then hypersonics are stabilizing.

The question remains, however, as it does with most strategic literature, what exactly should decision makers do knowing this information. Studies on strategic stability were born during the Cold War, and the aim of these studies was to describe what a strategically stable relationship looked like, and what to do if particular technologies, doctrines, or postures undermined this strategic stability. Thus it was also tied intimately towards arms control and its associated literature. Since the goal of deterrence is to avoid nuclear war than states should pursue strategies and their related technologies that foment the most strategically stable relationship; because stability relates to the state in which general nuclear war is least likely to occur- not that cannot occur for a variety of political and other reasons in a stable relationship, but that a stable relationship has less risk of war than an unstable relationship. This is also the period when MAD became intimately tied

to strategic stability between great powers. Although much has changed since the Cold War, the fundamental strategic relationship between the great powers today is one of deterrence premised upon MAD. Moreover, technological development in one way or another can never truly be stopped it seems; and thus it is still the responsibility of the strategic studies discipline to examine the effects of new technologies, doctrines, and postures of the great powers; and from those studies make educated prescriptions about policy direction.

The spectre of a general nuclear war still haunts the modern world, even if most have forgotten it. Much has been made in the past 30 years describing a new international security relationship, one in which MAD had receded into the background of international peace and security. Understandably, developments such as 9/11 and other security concerns shifted the focus of strategic studies. Still, if one looks closely the threat of nuclear conflict remained prescient in the strategic maneuverings of states since the end of the Cold War. Much of Russian and Chinese aggression in their respective spheres of influence is still guaranteed by nuclear weapons. Although counterfactual, it is not hard to imagine the United States acting differently with these countries had not both had nuclear weapons-i.e. Ukraine, Syria, South China sea etc. Still, the old strategic study of nuclear and strategic deterrence is coming into view and as such the revival of the study of strategic stability is natural in this sense.

Indeed, the development of hypersonic weapons in general, and hypersonic glide vehicles in particular, represents the first major technological development of these weapons since the Cold War. As with technologies in the Cold War such as ABM and MIRV, each new technology must be studied so that educated policy decisions can be

made by the great powers moving forward. Thus the implications of whether or not hypersonic glide vehicles are stabilizing or not is directly relevant to whether the states that have or will have them in the near future, should either unilaterally, bilaterally, or multilaterally control them; or conversely, adopt and implement them on mass.

Under comprehensive examination of all the factors that relate to strategic stability, it becomes evident that hypersonic glide vehicles will stabilize the relationship between the three great powers. Similar to their MIRV counterparts during the Cold War hypersonic glide vehicles are a particular response by states to increase the parity of their strategic relationships, and make their threats of assured destruction credible. Hyperglides offset ballistic missile defences and offer the ability for increased restraint when compared to their ICBM counterparts in their utilization as escalatory devices. They are better placed to escalate for the purposes of de-escalation and thus induce increased stability to a strategic relationship. The theoretical matrix indicates that it is highly plausible that moving forward these weapons will stabilize rather than de-stabilize the strategic relationships between the three great powers. Theoretically, and historically- if MIRVs are indeed a similar case- then it is plausible that hyperglides will only serve to stabilize the strategic balance between the great powers.

Interestingly, this paper argues contrary to the majority of current strategic opinion concerning hypersonic glide vehicles. It is likely that the discrepancy arises from the recognition that there are two ways to interpret the goal of modern strategic deterrence. Most of the community, at least implicitly, seems to reflect the belief that strategic deterrence is directed toward avoiding any strategic exchange. Similar to their historic counterparts during the Cold War, they overvalue the weight of counterforce

against the other dimensions of stability. Ultimately, American, Russian, and probably Chinese deterrence is not in fact directed towards avoiding any strategic exchange but rather directed toward avoiding a general war, and the civilizational costs associated. American strategy since the 1960s is an implicit proponent of the notion that escalation can be utilized to de-escalate before falling into a general war. So too, modern Russian strategy has adopted an escalate to de-escalate strategy for the purposes of not falling into an general war.¹⁵⁹

Deterrence deals with perception and psychology, indicating that if the United States, and Russia believe that credible deterrence is one that allows for escalation then both implicitly believe in the ability for escalatory strategies to de-escalate a conflict. This means inherently that counterforce weapons have a positive impact on credibility, and through credibility to MAD and stability. A theory that does not take into account the strategic doctrines and beliefs at least generally of the parties involved would fail to provide decision makers with policy decisions that will be enacted. Thus policy prescriptions should seek to understand the strategic balance as it is and provide the best advice it can regarding policy to positively impact the perceived stability of the relationship. Deterrence is unique psychologically, because it relates to the recognition that if states believe a relationship is stable it is more stable. In this sense counterforce targeting is stabilizing because the great powers believe it to be stabilizing. In any case it is the failure of the majority of hyperglide literature to properly understand the goal of

¹⁵⁹ Mattis, James. "Nuclear Posture Review 2018". Pg. 8. And Robert Work and James Winnefeld, Testimony before the Committee on Armed Services, (U.S. House of Representatives, 25 June 2015), 4.

modern deterrence and thus they accidentally claim that weapons systems, such as hyperglides, de-stabilize the relationship when in fact they stabilize it.

Recognizing then that hyperglides positively affect strategic stability, it is the position of this paper that this technology should be readily adopted by all the great powers. Indeed, they should not be controlled until their strategic aim has been met, and increased forces would overrun on costs. If that becomes the case, states should seek to control them on the back end laying out as they did with SALT I and the Vladivostok Accords, the strategic limits and boundaries of the relationship once all three parties are satisfied with their forces. In this regard, after full deployment the parties can engage one another and add increased stability by setting the upper limits of what the relationship will look like; and in so doing more readily cement the strategic stability between them.

This should not be confused with the actual control of the weapons; as any control before great power strategic parity has been achieved would a) not be possible because the Chinese and Russians would not agree to being so inferior and b) cementing disparity as it exists now would potentially over time begin to shift the relationship from parity to supremacy and in said shift the relationship would be de-stabilized. At its heart, arms control should not be about refusing technological innovations. Rather, it should be directed toward controlling the affects that arms have on strategic relationships; meaning both that if a technology undermines the relationship it should be limited and controlled, and if a technology seeks to create a more stable relationship it should be adopted fully to each party's extent and then have boundaries set, once all parties are convinced of the stability of the relationship vis-à-vis that technology. Hyperglide vehicles will stabilize the relationship, which over the past 30 years has become neglected; bringing increased

stability to the relationship and decreasing the likelihood of war. As such the great powers should welcome this technology and its beneficial effects on strategic stability.

Unfortunately, this study was limited by scope and length such that it had to make particular decisions about what to include and what to leave for further research. The theory created seems powerful at examining the effects of new offensive strategic weapons technologies on strategic stability. Future research, however, should be done to provide more evidence for its utility. In its current state it has provided the theoretical model necessary to envision the plausible effects of hypersonic glide vehicles on strategic stability. The theory was validated historically with MIRV, but unfortunately, the scope of the paper makes it impossible to see if the theory applies to all technological developments. Indeed, it may be the case that the theory only applies to offensive missile systems and is incapable of describing as comprehensively why certain defensive systems or other offensive innovations in the strategic realm would or would not be stabilizing. More studies of technology would serve to move the theory from one directed toward explaining the effects of offensive missile systems on strategic stability to a more general theory of technology and stability. If it can be validated across many technological innovations, in different historical periods, then it could move from a specific theory to a more generalized theory. The goal being if properly constructed, arms controllers would have the tool necessary to consistently measure the effect of technology on strategic stability and provide a consistent understanding across the discipline about what modern stability is premised upon and directed toward.

So too, it would be important to examine with further research if this is purely a technological theory, or if it could similarly deduce the effects of doctrine and strategic

posture on stability. It seems that doctrine and posture are intimately linked to technology in such a way that it may be feasible with increased study to see if the theory can accommodate these notions within its explanatory framework. For example, could a doctrine such as flexible response be input into the theory to describe its effects on stability. While it seems plausible to this writer, more investigation would have to be done to examine its validity in this realm.

Finally, the theory is constructed in such a way that it is designed to be acultural. That is, it does not take into account the strategic cultures of those involved to any major degree outside direct statements concerning technological implications on strategic posture. Deterrence is different to the Russians, Americans, and Chinese, and ultimately the theory provided seeks to understand at a base level outside of these strategic cultures what the plausible implications are of the technology upon a general strategic stability. For this study to become fully comprehensive it should take into account the different strategic conceptions of deterrents, weapons, offence, defence, and a host of other particularities that arise from specific cultural understandings about war. This falls under the umbrella of a study on strategic culture, which for scope reasons was impossible in this study. The addition of this study would increase the validity exponentially, because ultimately politics triumphs over technology such that the political realms perceptions, one way or another, do indeed impact how states and adversaries perceive weapons- and in deterrence perception matters.

In ending, this paper discovered a gap in the current literature concerning the strategic implications of hypersonic glide vehicles on strategic stability. Where most saw a dangerous technology in need of control, this paper argued that these weapons will

actually help to establish more stable relations and peace between the great powers. It constructed a unique theory that sought to comprehensively understand what strategic stability is and how technology might affect it. In so doing, it provided a comprehensive theoretical framework to test the plausible implications of hyperglides on strategic stability in the modern world. It validated its theory historically providing evidence that the theory properly conceptualizes what strategic stability is, and how technology interacts with it in the real world. It found that contrary to the foreboding of modern arms controllers, hyperglides will in all likelihood stabilize the strategic relationships of the great powers bringing all involved the technological capability to assure the destruction of their enemies, and in so doing deter nuclear war. Thus states and individuals need not be concerned that we are getting closer to war, but rather that hyperglides are taking the world further from war than is case without them. Their adoption is prudent and should not be perceived as de-stabilizing. Although paradoxical, perhaps, increased destructive capacity accompanying nuclear weapons has laid the foundations for global peace and security since the nuclear era began; hyperglides are merely a new delivery vehicle designed toward the same purpose. The great powers have and hopefully will remain readily convinced of the insanity of a general nuclear war- ensuring peace and security for future generations as it was for the Cold War generation. *If you wish for peace, prepare for war*; this Roman proverb describes the precarious relationship between peace and the threat of war- it has only become more poignant in the hypersonic era.

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