

Nuclear Deterrence and the Security Dilemma in a Complex Multipolar World

Original article

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Abstract

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Objectives: The purpose of this research project is to examine how nuclear deterrence intersects with the concept of security dilemma, i.e., when a state takes an action intended to increase its own security it may inadvertently create a risk or threat to another state and contribute to increased levels of tension. Fourth, how nuclear and conventional systems are becoming increasingly interconnected, which will serve to potentially amplify risks associated with these systems.

Results: The results of the study demonstrate that nuclear weapons can provide security through mutual vulnerability (i.e., they can help stabilize an unstable relationship). The degree to which this occurs depends upon whether states have reliable second-strike forces. Moreover, new technologies (e.g. cyber warfare, hypersonic weapons, etc.) are reducing decision timeframes and creating greater incentives for states to act pre-emptively. Third, the need to maintain survivable second-strike capabilities

Conclusions The authors conclude the study by identifying the implications for global stability and providing several policy recommendations to better manage nuclear risks in a rapidly changing strategic environment.

1. Introduction

The security dilemma developed by John Herz (1950) and expanded upon by Robert Jervis (1978) is one of the major concepts in International Relations Theory. The security dilemma can be explained as an unfortunate circumstance in which countries or states seek to improve their own security through increasing their military capabilities. However, these actions will inevitably make other countries or states feel less secure. In response to this perceived threat, they will take action to increase their own military strength; thus, creating a series of events resulting in each state being less secure than it had been prior to initiating the cycle. Because of the sheer magnitude of devastation caused by nuclear weapons, their presence dramatically increases the potential of worsening the already difficult process of resolving the security dilemma. Strategists, policy makers and academics alike have debated how to successfully resolve the problems associated with the security dilemma regarding nuclear weapons for many years.

During most of the period known as the (Cold War), U.S. -Soviet nuclear deterrence seemed to provide a level of stability in regard to the U.S.-Soviet security dilemma. The term “Mutual Assured Destruction” (MAD) refers to a scenario in which both superpowers possess a second-strike capability, i.e., each side has enough remaining offensive capability after absorbing a massive nuclear attack to inflict an unacceptable amount of harm on its opponent. Under MAD, no country would benefit from launching a first strike against another country because doing so would likely result in both countries suffering equally severe consequences. Therefore, under MAD, neither country would attempt to launch a surprise attack. Jervis (1984) concluded that nuclear weapons may even help alleviate some aspects of the security dilemma if there exists a condition of mutual vulnerability among them. The idea behind this conclusion is simple yet very strong: If two states are both capable of unleashing devastating retaliatory attacks, then both states will be reluctant to engage in conflict because neither state will want to suffer the consequences of such an attack. In essence, mutual vulnerability creates a self-enforcing restraint mechanism that suppresses the security dilemma rather than exacerbating it.

The current nuclear environment is dissimilar to that of the Cold War. While the return of a U.S.-China-Russia great power rivalry, as well as proliferations in North Korea, Pakistan, and India, have brought back elements of the "security dilemma" dynamic that were thought to be at rest since the end of the Cold War, they present themselves in a very different way than did their Cold War analogs. Additionally, the emergence of technologies such as cyber warfare, hypersonic missiles, artificial intelligence and missile defenses challenge many of the key assumptions regarding warning time, escalation control and secondstrike survivability which had previously been assumed by deterrence theory. Finally, the erosion of arms control architecture such as the demise of the Intermediate Range Nuclear Forces treaty and the uncertain fate of New Start has diminished both transparency and certainty thereby creating an atmosphere conducive to worst-case scenario spiral development (Acton, 2018; Pifer, 2021).

Therefore, we are confronted with pressing theoretical and policy concerns which the existing body of literature on nuclear deterrence cannot adequately address. Can nuclear deterrence continue to provide a basis for stabilizing security dilemmas in today's world given

the changing nature of technology and geopolitics. What will be the effect of new technologies upon the credibility of nuclear threats and the risk associated with the escalation of conflict. Will proliferation of new nuclear states create a similar type of stable deterrence relationship that existed historically between the United States and the Soviet Union, or will regional nuclear dilemmas have entirely unique attributes. How will the erosion of arms control impact on strategic stability and what alternatives could replace it.

The article will address these issues with a systematic and qualitative examination of primary documents over an 80-year span of nuclear history. Four new conceptual frameworks have been developed to provide insight into the dynamics of nuclear security dilemma (NSD) today:

First, Deterrence Credibility Asymmetry represents an unequal ability to be perceived as credible in issuing nuclear threats across various types of dyadic relationships, environments, or subject matter areas. Factors such as domestic political considerations, obligations based on alliances, conventional military power ratios, reputation-based risk, type of interest at stake, and technical characteristics of weapon delivery systems and decision-making architectures influence the degree of DCA within dyad relationships. This framework disputes assumptions about the credibility of nuclear threats and suggests that credibility is social construction and has multiple dimensions as well as being influenced by both structural and relational aspects of relationship between states.

Next, Escalation Risk Perception Gaps describe the systematic perceptual errors of nuclear powers regarding adversary escalation threshold because of cognitive bias, organizational behavior and systemic constraints related to information asymmetry and opaque decision processes. ERPG creates miscommunication/meaning mismatch between intentional signal from one state and the actual interpretation by another state: thereby creating a high risk of unintended escalation regardless of if neither party desires conflict. ERPG also helps explain why seemingly rational actor(s) in mutually beneficial situations may escalate into catastrophic conflict.

Thirdly, Second Strike Stability Thresholds identify the minimum levels of survivability, delivery vehicle requirements needed for nuclear deterrent stability. Rather than assume all second-strike capabilities are sufficient for nuclear deterrence stability (SST), this framework defines the conditions under which nuclear weapons either inhibit or exacerbate security dilemmas. Additionally, SST provides analytical tools for determining how newly emerging technologies alter existing SST and thus may destabilize prior stable dyad relationships.

The four above-mentioned conceptualizations of the nature of current threats in terms of nuclear security issues are based upon thorough analysis of documents as well as applied to contemporary nuclear challenges. The article continues as follows. In section two we describe in detail our method of analyzing qualitative documents. In section three we introduce and explain these four theoretical contributions supported with significant documentation. Section four presents five main results of our systematic document analysis. Section five discusses four implications for international security and for strategic stability. Section six provides four policy recommendations for managing nuclear security dilemmas.

Finally, section seven present conclusions concerning future of nuclear deterrence and potential future research.

2. Methodology

Qualitative document analysis will be used as a methodology to answer the research questions of this dissertation. The use of qualitative document analysis to examine and interpret the meanings embedded within written texts has become an increasingly accepted and powerful form of social science inquiry (Bowen, 2009). In contrast to quantitative content analysis which typically uses frequency coding to identify trends within large datasets, qualitative document analysis emphasizes interpretation, context, and the discovery of emerging themes, patterns, and discourses found within textual materials. Therefore, qualitative document analysis is well-suited to analyze official documents regarding nuclear deterrence because such documents represent the most direct means by which states demonstrate how they conceptualize and operationalize strategic ideas and policies regarding deterrence, credibility, escalation, and stability.

There are multiple advantages of using document analysis to investigate nuclear strategy. First, many aspects of nuclear strategy are formalized in documents created by governments and other authoritative actors. These documents contain much primary-source information that provides a wealth of detail about how states develop and implement their nuclear strategies. Second, when analyzing official documents regarding nuclear deterrence, researchers can obtain an "emic" perspective, i.e., the perspective of the actor whose actions are being studied. This is important because there may be discrepancies between what actors believe and say they do and what actually occurs. Official documents can also help identify how actors conceptualize and understand concepts like deterrence and escalation. Additionally, official documents can help identify how actors' views on these issues evolve over time. Since documents reflect policymakers' perceptions at specific times in history, they are a non-reactive type of data collection instrument and therefore generally free from researcher-induced biases that occur with instruments such as interviews and surveys. Furthermore, since documents often record policymakers' immediate reactions to crises, they offer a unique opportunity for researchers to gain insight into the nature of deterrence during moments of heightened tension (Prior, 2003; Atkinson & Coffey, 2011).

As previously stated, the documents selected for this project were chosen according to the following criteria:

Firstly, all documents had to come from authoritative sources (e.g. national governments, international organizations etc.). Secondly, the selected documents had to deal with some aspects of nuclear deterrence in substantive detail. Thirdly, all selected documents had to be publicly available and could be confirmed through reputable sources. Finally, the time covered spanned the duration of the nuclear age from the Trinity test in 1945 up until today allowing researchers to compare stability during the Cold War with current concerns. The document corpus was divided into seven categories to ensure that all types of nuclear strategic discourse would be represented:

Category One included national nuclear posture documents such as U.S. Nuclear Posture Reviews (1994; 2001; 2010; 2018; 2022); Russian Military Doctrine and Nuclear Policy Statements; Chinese Defense White Papers dealing with Nuclear Forces; British Strategic Defense and Security Reviews; French Livre Blanc on Defense; Indian Nuclear Doctrine Documents; Pakistani Strategic Policy Statements; North Korean Official Announcements as available.

Category Two consisted of strategic arms control treaties and related documentation: Limited Test Ban Treaty (1963) Nuclear Non-Proliferation Treaty (1968) SALT I and ABM Treaty (1972); SALT II (1979); Intermediate-Range Nuclear Forces Treaty (INF Treaty) (1987); Strategic Arms Reduction Talks (START) I (1991); New Strategic Arms Reduction Talks (New START) (2010) and their verification protocols, implementation documents and negotiation records;

Category Three comprised defense white papers and military strategy documents from nuclear armed states: U.S. National Security Strategies (1987 - 2022); Russian Foreign Policy Concept and National Security Strategy; Chinese Defense White Paper (1998 - 2019); NATO Strategic Concepts; Major Doctrinal Statements from Other Nuclear Armed States.

Category Four included Presidential Doctrines/Executive Branch Policy Documents: Memorandums from the National Security Council; Presidential Directives; Executive Orders; National Security Decision Directives on nuclear weapons policy, targeting doctrine and employment guidelines.

Category Five consisted of historical crisis records: Declassified Records from the Cuban Missile Crisis (1962); Alert Crisis (1973); Able Archer War Scare (1983); Kargil Crisis (1999); India/Pakistan Standoff (2001 - 2002); North Korea Crisis (2017); And other major nuclear close calls.

Category Six included Major Policy Speeches/Directorial Statements/Public Communications from Heads of State, Secretary of Defense/Military Commanders/Foreign Ministers Addressing Nuclear Deterrence/Escalation/Strategic Stability.

Category Seven included seminal scholarly/think tank assessments that influenced official policy: Works of Brodie (1946); Schelling (1960; 1966); Kahn (1960; 1965); Waltz (1981); Contemporary Assessments from Institutions such as RAND Corporation; Carnegie Endowment for International Peace; International Institute for Strategic Studies; Federation of American Scientists.

A total of 50 documents comprise the final document corpus. Documents were equally distributed across all time periods examined in this study. The geographic distribution of the selected documents mirrors global power structure. All major nuclear armed states were adequately represented. Document selection occurred iteratively: Initial sampling began with knowledge of key documents followed by snowball sampling via citation tracking/archival cross reference/secondary literature review (Scott, 2014).

The document analysis involved five stages of systematic processing to guarantee consistency and reproducibility throughout the research. Firstly, we did a descriptive coding stage. The goal of this stage was to group documents according to their source (author), date, type,

intended audience, subject matter and date. Descriptive coding provided us with a solid base for comparative analysis.

Secondly, we applied thematic analysis. Thematic analysis is an approach used to find common themes or patterns in large data sets. In this study, we looked at recurring concepts, arguments, policy positions and frames regarding deterrence; the security dilemma; escalation; credibility; and stability. We followed an iterative theme development process where initial codes are based upon relevant theoretical literature and additional codes are created as other themes emerge during the data collection process.

Thirdly, we did interpretative analysis to explore how these documents frame causal relationships between the use of force; capability; strategic posture; and stability outcome. Interpretative analysis allowed us to see which underlying assumptions were made in the official documentation, what evidence was being relied upon, and what logic was being employed.

Fourthly, we did a comparative analysis of different countries; time periods; document types; and crisis events to determine if there is a pattern in how deterrence discourse is framed in official communications. Comparative analysis helped us identify both general principles about nuclear strategy and country-specific differences in how states think about deterring adversaries using nuclear threats.

Fifthly, we did a longitudinal (historical) comparison to observe the emergence of key terms including mutually assured destruction; escalation dominance; flexible response; counterforce; extended deterrence; and strategic stability into policy documents; the changes to the meanings of those terms over time; and whether certain terms fell out of favor.

Lastly, we used negative case analysis to examine documents and episodes that contradict prevailing patterns to help evaluate the validity of our results.

Our coding system developed through an iterative process involving initial coding; team discussions; refinement of codes and re-coding. Initially, our codes were generated from deterrence theory and security dilemma literature. These included codes for a first strike; a second strike; escalation; de-escalation; credibility; vulnerability; survivability; arms races; transparency; verification; proliferation; deterrencefailure; crisis management; and communication. As we read through the data, additional codes emerged as new themes developed. Additional emergent codes included cyber vulnerabilities; hypersonic missiles; missile defenses; artificial intelligence applications for nuclear command and control systems; and entanglements between different domains. To enhance the reliability of our coding system, two coders coded a 20% subsample independently. Our intercoder reliability score was 85%, which indicated strong agreement between coders. All discrepancies were resolved through discussion and consensus-building.

Inherent within document analysis as a methodology there exist some significant limitations that must be acknowledged by researchers who use the methodology.

Firstly, documents are representative of "official" policy-making processes that do not always clearly capture the nuances and controversies that occur internally among

policymakers, nor do they necessarily represent the range of actual or hypothetical military capabilities or decision-making processes in response to crises. The purpose of official documents is generally to present a unified position; therefore, documents usually reflect the product of negotiation and compromise. Therefore, official documents will normally reflect only one perspective at best. In order to mitigate this problem, we have utilized memoirs by senior officials, investigative journalism, and declassified internal memoranda wherever possible to support our analysis of official documents.

Secondly, documents are created for domestic and international consumption and thus may intentionally downplay the true intentions, capabilities, or "red line" thresholds associated with national security policymaking. States may deliberately misrepresent their capabilities, bluff regarding their commitments, or conceal their willingness to go beyond certain thresholds. Again, we have mitigated this problem by comparing documents over time and across different contexts and analyzing potential differences in content and/or intent that suggest strategic deception.

Thirdly, due to classification issues, there is limited access to current day classified military assessments, intelligence estimates, real-time crisis management communications, and internal policymaking memoranda. Wherever feasible we have relied upon declassified records and acknowledged uncertainty when such records were unavailable.

Fourthly, since documents produced under authoritarian governments tend to be less transparent than those produced in democratic societies, and since rhetorical style, level of candor and availability also vary significantly between governments, cross-government comparisons are complicated. Therefore, we have been particularly attentive to government-specific patterns of communication and whenever feasible, triangulated against observed behavior.

Finally, document-based methods of analysis cannot provide a comprehensive picture of the complex psychological factors involved in nuclear decision-making, nor can they account for the organizational dynamics and situational pressures experienced by those engaged in nuclear decision-making. Thus, while we acknowledge that document-based methods of analysis have limitations with regard to capturing all aspects of nuclear decision-making, we believe that they remain the primary methodology for researching nuclear deterrence because they allow analysts unprecedented access to official strategic discourse.

3. Theoretical or Conceptual Framework

3.1. Deterrence Credibility Asymmetry

The first theory contribution is based upon the concept of Deterrence Credibility Asymmetry, which represents the unequal distribution of nuclear threat credibility across various dyads, contexts, issue areas, and time frames. This occurs due to a variety of interrelated elements that include domestic politics, alliances, conventional force balances, reputation, type of interests at stake, characteristics of the weapons themselves (delivery systems), the command architecture, and the history of previous crisis interactions.

Credibility of deterrence has historically been viewed as a central problem within the realm of nuclear strategy. According to Schelling (1960, 1966), it is the very credibility of the threat necessary to deter an adversary from attacking that makes carrying through with such

a threat rational. In the context of extended deterrence, however, the problem of credibility is especially acute since a nuclear state will retaliate on behalf of its ally when faced with an adversary who does not pose a direct threat to the nuclear state's own homeland. Much of the current literature views credibility as being largely a function of both capability and resolve; thus, systematically underestimating the consistent and systemic inequalities characteristic of all nuclear deterrence relationships. Our document review indicates that deterrence credibility is not simply a yes or no question. Rather, we find that there exists a significant amount of variability in terms of how much credibility can exist in relationo differing dimensions. We identify four major causes of Deterrence Credibility Asymmetry.

Firstly, interest asymmetry impacts credibility. For example, defending core national territory from direct attack is generally considered to be more credible than attempting to defend less critical territorial interests or those belonging to an ally. Documents related to U.S. nuclear policy continually cite homeland defense as the most credible use of nuclear weapons. Specifically, the 2018 Nuclear Posture Review states that "the most basic obligation of the U.S. nuclear arsenal is to deter nuclear attacks on the United States, its allies and partners." (U.S. Department of Defense, 2018) Likewise, while extended deterrence obligations to allies are articulated in formal statements, they are always framed with caveats regarding consultation prior to any decision to engage in retaliatory action, situational considerations, and the nature of the perceived threat. These stipulations indicate the inherent limits to credibility. Similarly, Russia also distinguishes between threats directed toward their homeland versus those directed toward other peripheral interests.

Secondly, capability asymmetries are systematic on the issue of credibility. States with viable retaliatory second-strike capabilities - i.e. multiple weapon systems; alternative Command & Control centers, etc. - have greater ability to credibly threaten an adversary than do states whose weapons systems are vulnerable. Documents from China repeatedly state that the viability of China's nuclear forces is central to its ability to credibly deter adversaries. For example, "China maintains a nuclear arsenal that is small in size but sufficient to ensure its own defense" (State Council Information Office, 2019) and, also, that reliability and survivability are the most important criteria. Russia too emphasizes the importance of multiple means of delivering nuclear attacks - e.g., intercontinental ballistic missile launchers carried by vehicles; long range submarine-launched ballistic missiles; strategic bomber aircraft; etc. to increase the credibility of Russian nuclear threats (Ministry of Foreign Affairs of the Russian Federation, 2023).

Thirdly, reputational asymmetries also impact credibility. States that have demonstrated an increased likelihood to engage in escalatory behavior in previous conflicts have created reputations that contribute positively to the credibility of potential future threats. There are many examples of how U.S. and Soviet leaders during the Cuban Missile Crisis used restraint when issuing threats against each other, while simultaneously making it clear they were willing to go to war if necessary, so as not to lose credibility for subsequent actions (National Security Archive, 1962). Today we see how North Korea has developed a reputation for being unpredictable and taking chances to increase the credibility of its threat to deter enemies

(Cha, 2012), as well as how Pakistan deliberately leaves open questions regarding its willingness to escalate into conflict (Narang, 2014).

Fourthly, domestic political asymmetries also negatively impact credibility. If a country has a divided government - i.e., one branch of government controlled by one party and another branch controlled by a different party - then there will be less confidence among foreign adversaries that threats issued by the divided government will endure beyond the term of current office holders. Similarly, countries with disputed elections or uncertain leadership succession will experience credibility problems because adversaries will question whether threats will continue beyond the tenure of present office holders. In fact, there are some United States' documents that suggest presidential transitions can cause credibility issues due to uncertainty (US Department of Defense, 2022). Likewise, there are Russian documents that imply that the democratic process undermines the credibility of commitments made among allies (Ministry of Foreign Affairs of the Russian Federation, 2023). Conversely, Chinese documents argue that internal political stability contributes to China's enhanced credibility vis-à-vis democratic nations (State Council Information Office, 2019).

Fifthly, technological asymmetry has an impact on credibility. Those countries who have developed advanced command and control systems and possess reliable early warning and communication capabilities are able to produce more credible threats than those countries whose systems are fragile and susceptible to failure. Cyber vulnerabilities create additional credibility asymmetries among states because if a state fears that its command system will fail then it may delegitimize its authority by delegating to another body to establish a Launch on Warning posture which would also affect the credibility of the threat (Sanger, 2018).

Conceptualizing deterrence credibility asymmetry builds upon extant research in four respects. Firstly, this concept challenges the assumptions inherent within prior scholarship that threats made using nuclear weapons are always credible, or that credibility is solely based upon a state's capability. Instead, it posits that credibility is socially constructed, context dependent and systematically asymmetric. Secondly, it articulates various processes whereby credibility is both constructed and/or destroyed among dyads.

Thirdly, it enables analysts to examine the problems of extended deterrence in a multi-polar world wherein credibility is required to be sustained among multiple allies and adversaries simultaneously. Fourthly, this concept explains why certain dyads experience stable deterrence whereas other dyads experiencing comparable force structures remain unstable.

3.2. Escalation Risk Perception Gaps

The second major theoretical contribution is the idea of Escalation Risk Perception Gaps, which represent systematic differences between how nuclear-armed nations view and evaluate their own escalation risks, thresholds, signaling intentions, and how these same risks, thresholds, intentions are evaluated, interpreted by their adversaries, resulting in dangerous misinterpretations of signals sent and received that could lead to unintended escalation, miscalculating coercive intent or crisis instability where there was previously no preference for going to war.

Risk perception gaps were identified by Jervis (1976) as a source of crisis instability in International Relations. He illustrated how misperceptions led to a number of Cold War crises including the Korean War, the Cuban Missile Crisis, and the Vietnam War. Kahn (1965), similarly, highlighted the need to understand the escalation thresholds of your adversary, and cautioned against assuming that your own escalation thresholds would be known to them. While research has focused on various aspects of crisis management and deterrence in general terms, it has failed to develop a comprehensive theory regarding how perception gaps might form specifically within nuclear dyad relationships, and how they relate to security dilemma dynamics at present.

Analyzing documentation reveals a variety form of escalation risk perception gaps occurring throughout all nuclear dyad relationships.

Firstly, threshold perception gaps exist when two nations do not agree upon what level of military action represents crossing an escalation threshold - e.g., conventional warfare to nuclear warfare, limited nuclear use to total war, or peacetime activities to crisis situations. For example, U.S. governmental reports view cyber-attacks on early warning systems as being potentially escalatory. In particular, the 2018 Nuclear Posture Review states that "Significant Cyber Attacks on U.S. Nuclear Command and Control Systems Could Be Viewed as Strategic Attacks." (U.S. Department of Defense, 2018). Similarly, Russian government reports express concerns over conventional strikes on nuclear command and control centers. They warn that if this type of attack were made upon Russia, then they would consider the attack to be so egregious that they would respond with a nuclear counterattack. (Ministry of Defense of the Russian Federation, 2019). China expresses its views that deployment of missile defense systems will create firststrikeperceptions among nations, citing that Missile Defense Systems That Can Undermine Strategic Stability are a Matter of Serious Concern. (State Council Information Office, 2019). When nations' views of escalation thresholds differ significantly from one another, what one nation considers to be a minor military act may be seen by the other nation as an existential threat causing each side to escalate beyond what either had initially planned or desired.

Second, crisis stability perceptions are based upon states' different views regarding the degree to which crises can be controlled versus their tendency to escalate. Documents from the U.S. during the Cold War reflect an assumption of the ability to limit and control nuclear use through graduated escalation; and the flexible response doctrine was specifically created to allow for such controlled escalation (McNamara, 1968). However, documents from the Soviet Union indicate a greater distrust in the concept of crisis stability. Strategists within the Soviet Union viewed any type of nuclear exchange as likely to escalate into a full-scale conflict (Gaddis, 2005). More recent documents demonstrate ongoing disagreements over whether limited nuclear exchanges are feasible and/or whether any nuclear use would inherently result in escalated conflict. In fact, the 2022 U.S. Nuclear Posture Review stated that "the United States would only consider the use of nuclear weapons in extreme circumstance", however it did not disavow limited nuclear options (U.S. Department of Defense, 2022). Conversely, Russian government documents express much more pessimism toward

the potential for limited nuclear conflict, stating that "any use of nuclear weapons would result in catastrophic consequences" (The Ministry of Foreign Affairs of the Russian Federation, 2023).

Third, signaling perception gaps occur when one state misinterprets another state's deterrent signal, perceiving coercive threats such as bluffs or routine posturing as threatening behavior. Documents related to the 1983 Able Archer incident reveal that the Soviet Union misperceived a routine NATO military exercise as preparation for a nuclear first strike that brought the world to the brink of nuclear war, a level of risk previously underestimated by contemporaries (National Security Archive, 1983). While Soviet intelligence analysts viewed NATO communications activity, troop movement and exercise scenarios as indicative of preparatory activities for a real attack, NATO planners were engaged in routine training exercises. As a result of this perception gap, there was almost certainly to have been catastrophic escalation, although neither side possessed any hostile intentions. Contemporarily, there continue to exist significant issues with respect to signaling as evidenced by the differing interpretations of North Korea's missile test activities. Specifically, the U.S. has viewed these actions as provocative and threatening whereas, North Korea has viewed them as normal training and testing procedures (Cha, 2012).

Fourth, perception gaps caused by technology occur when new capabilities create uncertainty about dynamic escalation that neither side fully understands. Hypersonic weapons are designed to compress decision timelines, therefore creating perception gaps with respect to warning time and response options. The 2022 Nuclear Posture Review identifies "hypersonic glide vehicles could reduce warning times and increase uncertainty about adversary intentions" (US Department of Defense, 2022). Cyber operations against a state's nuclear command and control create attribution problems which generate perception gaps regarding responsibility and intent. Sanger (2018) documents how cyber-attacks can be designed to be ambiguous, thereby generating an escalation risk because victims cannot reliably attribute attacks to a state adversary or distinguish between espionage and preparation for attacks.

Fifth, communication infrastructure generates cultural and organizational perception gaps in the assessment of escalation risks. Different strategic cultures, organizational routines, and decision-making processes among states generate systematic differences in assessments. Schelling (1960) recognized that communication requires shared understanding; however, nuclear adversaries often lack this type of framework. Russian documents emphasize "escalation to de-escalation" strategies where limited use of nuclear force may coerce an adversary to de-escalate; this concept is found destabilizing in U.S. Documents (Kofman, 2021). Chinese documents identify "no first use" as a stabilizing commitment while U.S. Documents retain some degree of ambiguity regarding first use (State Council Information Office, 2019; US Department of Defense, 2022).

The concept of escalation risk perception gaps advances existing literature in four ways. First, it provides evidence for how crisis can escalate to nuclear confrontation even when no side wants war and all actors are rational. This challenges assumptions that escalation requires aggressive intentions. Secondly, it identifies specific mechanisms through which misperception operates within nuclear dyads. Thus far, most arguments about misperception have been generalized. Thirdly, it provides analytical tools for crisis management

and communication by identifying intervention strategies to reduce these specific types of gaps. Finally, it provides an understanding as to why some dyads remain volatile despite similar forcepostures while others do not. Over time, shared experience and communication infrastructure will reduce these gaps.

3.3. Second-Strike Stability Thresholds

Thirdly, there exists a theoretical notion of Second-Strike Stability Thresholds, defined as the lowest level of weapons, the least effective method of delivering those weapons, the least robust command & control structures, the least capable early-warning systems, and the least aggressive strategic posture necessary for a stable nuclear deterrent environment; below such threshold, first-strike incentives will arise and security dilemmas will grow rather than recede. Mutual Assured Destruction has provided the core idea behind strategic stability thinking since the 1960s. However, until now, no theoretical definition has identified the exact conditions for an adequate secondstrike capability. That is to say, what weapon levels are required for a survivable deterrent? How hard should silos be? How many ballistic-missile-submarines need to be deployed? What redundancies are needed in command systems? And how reliable does early warning need to be? Finally, how do these thresholds differ between different dyads and different technologies? The concept of second-strike stability thresholds answers these questions.

A review of documents related to second-strike stability thresholds indicates that they depend upon a number of interdependent variables that collectively determine whether a particular dyadic relationship experiences mutually stable deterrence or first-strike incentives.

First, survivability requirements: in order to survive a first strike and subsequently retaliate, a second-strike force must possess survivable characteristics. Survivability is typically achieved through hardened basing methods, mobile launch vehicles, the presence of ballistic missile submarines at sea, or some combination of the above that complicates an enemy's ability to target. U.S. government documents consistently argue for diversifying the nuclear triad to provide survivability. The 2022 NPR states that "the triad provides unique advantages in assuring survivability." (U.S. DoD, 2022). Russia emphasizes both mobile systems and diverse basing methodologies. Mobile ICBM systems offer survivability due to their mobility and concealment. (Russian Ministry of Foreign Affairs, 2016). China appears to be transitioning away from reliance on silo-based systems toward mobile systems to improve survivability. According to the 2019 White Paper on Defense: "China has made great strides in enhancing the survivability and reliability of its nuclear forces." (State Council Information Office, 2019).

Second, penetration requirements: the retaliatory forces must also be capable of penetrating into the enemy's defensive systems. The development of missile defense systems threatens second-strike stability because it allows enemies to intercept retaliatory forces thereby creating first-strike incentives by undermining the effectiveness of retaliation. The Preamble to the ABM Treaty (1972) explicitly recognized this logic when it limited the development of missile defense systems as a means of preserving mutual vulnerability. It stated: "Effective limitation by agreement on anti-ballistic missile systems would be a major step in the reduction of tension in the field of strategic offensive weapons and would inhibit further increase in strategic offensive arms which would decrease the risk of outbreak of war." (United States Department

of State, 1972). The end of the ABM Treaty and subsequent deployment of U.S. missile defense systems have caused both Russia and China to worry about second-strike stability. Both countries have expressed similar concerns regarding second-strike stability as follows: Russian documents state that "global missile-defense systems undermine strategic stability." (Russian Ministry of Foreign Affairs, 2016). Chinese documents indicate similar concerns: "Missile defense systems that could undermine strategic stability are something we take very seriously." (State Council Information Office, 2019).

Third, Requirements for Command-and-Control Systems; In order to be able to authorize retaliation after a first-strike, second-strike forces require survivable command and control systems. These command-and-control systems require redundant communication lines, multiple authentication pathways, procedural assurance of retaliating and being protected against decapitating strikes. All nuclear capable countries have made significant investments in survivable command systems, including airborne command centers (U.S. E-4B & U.S. E-6B) and Extremely Low Frequency submarine communications systems, as well as hardened ground-based facilities. The 2018 Nuclear Posture Review states that "Survivability of command and control is critical to deterring credible threats" (Department of Defense, 2018).

Fourth, Warning Thresholds; Stable second-strike deterrence also requires reliable warning systems that provide adequate time for decision-making and distinguish actual attacks from false alarms. False alarms have occurred twice during the Cold War era. A 1979 incident involved a training tape that was accidentally placed into an operational system simulating a full-scale Soviet attack. Another incident took place in 1980 where a faulty computer chip caused false alerts. Contemporarily there exist increased risk of false alarms due to cyber threats as malicious actors would have the ability to produce fake warning information and/or decrease the reliability of sensors (Sanger, 2018).

Fifth, Operational Posture; Declarative policy and operational posture also impact second-strike stability. No-first-use policies, launch-on-warning postures and delegated launch authorities can alter the stability thresholds. China has maintained a 'no first use' policy since 1964 and intends to improve stability by reducing the incentive to conduct a first strike (State Council Information Office, 2019). The United States maintains ambiguity regarding whether they will be the first to initiate a nuclear conflict, which increases their deterrent but reduces stability (Department of Defense, 2022).

Second Strike Stability Thresholds represents an advancement over prior work in four ways. First, Second Strike Stability Thresholds clearly defines the conditions under which nuclear weapons either diminish or augment the dimensions of security dilemmas, whereas previous studies tended toward categorically defining nuclear weapons as either enhancing security dilemmas (i.e., Mutual Assured Destruction) or diminishing them (i.e., Not MAD). Second, Second Strike Stability Thresholds recognizes the influence of newly emerging technology on the stability of dyadic relationships. Hypersonic weapons, cyber-warfare, missile defense systems etc. can lower stability thresholds thereby lowering what had previously been considered stable dyads below the stability threshold. Third, Second Strike Stability Thresholds provide analysts with the necessary tools to prioritize arms control efforts based upon which specific capabilities or postures would have the greatest effect on stability thresholds. Fourth, Second Strike Stability Thresholds

explains why certain dyads appear to possess second strike capability yet remain unstable if one or both parties fail to meet those thresholds.

3.4. Nuclear Entanglement Cascades

Nuclear Entanglement Cascades represents the Fourth theoretical contribution made toward understanding how the current environment has altered the nature of Strategic Stability. It refers to the complex interconnectedness between Conventional and Nuclear Forces within and across Multiple Domains; the interconnectedness between Alliance Commitments within and across multiple Nuclear Dyads; and the interconnectedness of Technology Systems, such that a Crisis/Conflict/Failure within one Domain/Dyad can cause an Escalation Risk in other Domains/Dyads via the Connections established by the aforementioned Interconnectedness.

Nuclear Entanglement Cascades addresses a primary shortcoming of Deterrence Theory developed during the Cold War Era. Cold War Deterrence Theory focused on bilateral relationships between two states (primarily U.S. vs. USSR), whereas Multipolar Theory addresses contemporary relationships among multiple states (U.S. vs. Russia, U.S. vs. China, Russia vs. China, India vs. Pakistan, U.S. vs. North Korea etc.), each of whom have commitments to each other as part of their respective alliances, utilize both conventional and nuclear forces, and have technological systems that support their military operations. As such, a Crisis in one relationship may affect another due to the previously identified interdependencies. Document Review indicates that there are several different forms of Nuclear Entanglement Cascades that are shaping Strategic Stability today.

First, conventional nuclear entanglement cascades refer to situations where conventional forces are linked to nuclear forces either technologically or organizationally in such a way that it increases the risk of escalation. During the Cold War Era, conventional and nuclear forces were relatively well segregated from one another, with the decision to escalate to nuclear force being a separate and distinguishable decision. Today's linkage of conventional and nuclear forces reduces that separation. For example, the deployment of Hypersonic Conventional Missiles by the U.S., potentially capable of being misidentified as nucleararmed missiles (Acton, 2018); or Russia's development of both conventional and nuclear versions of the same Delivery System making it difficult for an adversary to determine whether the next missile launched is conventional or nuclear (Acton, 2018).

Secondly entanglement cascades occur when alliance commitments link together multiple nuclear dyads. Examples include NATO's nuclear-sharing agreements which have created entanglements such that if there were to be a crisis over one NATO country, it could lead to the US and Russia engaging in a nuclear exchange; secondly, the U.S. Has committed to extended deterrence to protect Japan and South Korea from North Korea creating entanglements which could result in a US/China or US/Russia nuclear confrontation The “quad” alliance agreement (U.S., Japan, Australia and India) also creates entanglements between US/China and India/Pakistan.

Thirdly technological entanglement cascades occur when command and control systems for nuclear weapons are interconnected with other systems that create risks of cascading failure. For example, cyber threats to conventional military systems can impact nuclear command systems.

Systems used for early warning systems for both conventional and nuclear attacks can cause problems when conventional attacks can trigger nuclear warnings. Artificial intelligence systems integrating data from various domain areas may misread normal event occurrences as possible preparations for hostility.

Fourthly, theatrical entangling cascade dynamics occur when regional conflicts involve more than one nuclear power at the same time. In the ongoing Ukraine conflict, Russia is one of the two countries capable of delivering a nuclear response while the United States and its NATO allies support Ukraine. A hypothetical Taiwan conflict would create similar conditions for entangling dynamics with China being the nuclear power and the United States responding as a nuclear power, along with possible responses by Japan and Australia. The India-Pakistan dyad is also entangled with the US-China dyad due to alliances.

The 1983 Able Archer incident illustrates the entanglement cascade dynamic at play. What began as a routine NATO exercise (non-nuclear) was viewed by Soviet intelligence as a prelude to a U.S. Nuclear first strike. Although the crisis was confined to the U.S.-Soviet dyad, it was initiated by a NATO conventionally based military exercise in Europe (entanglement resulting from alliance commitments).

Conceptually, the idea of nuclear entanglement cascades builds upon prior research on the subject in several distinct ways. First, it expands upon existing literature by incorporating a transition from bipolar to multipolar forms of nuclear interactions. In doing so, the framework provides analysts with the necessary analytic tools to understand both how multiple dyads are interacting and how they are becoming "entangled". Second, the model illustrates how crisis escalation may occur across dyads (and not solely within them), thereby providing insight into potential avenues through which conflict expansion may be facilitated. Third, the proposed framework enables analysts to assess how emerging technologies may contribute to increasing entanglement risks. Finally, this conceptualization also identifies that maintaining stability will require managing the degree of entanglement among states as opposed to merely attempting to manage each individual dyad.

Table 1: Theoretical Concepts - Definition, Operational Mechanisms, and Empirical Indicators

Concept	Definition	Mechanism (Core)	Operation	Indicators	Stability Implications
Deterrence Credibility Asymmetry	Uneven credibility of nuclear threats across actors and contexts	Interest, capability, reputation, domestic politics, technology	Credibility varies (not binary); higher credibility enables deterrence with fewer resources; lower credibility requires overcompensation	US homeland vs extended deterrence; Chinese survivability focus; North Korean unpredictability; Russian doubts on alliances	High asymmetry destabilizes via fear and overreaction; balanced credibility stabilizes
Escalation Risk Perception Gaps	Mismatches in how states interpret escalation risks and signals	Threshold, signaling, crisis, technological, cultural gaps	Misinterpretation drives unintended escalation; gaps widen without communication and shared experience	Able Archer 83; cyber concerns; Russian and Chinese threat perceptions	Large gaps increase accidental escalation; smaller gaps improve stability
Second Strike Stability Thresholds	Minimum survivable capability needed for stable deterrence	Survivability, penetration, command and control, warning, posture	Above threshold → mutual vulnerability; below → first strike incentives and arms racing	Anti-Ballistic Missile Treaty; nuclear triads; false alarms; no first use policies	Above threshold stabilizes; below threshold destabilizes, especially with new tech
Nuclear Entanglement Cascades	Interconnected nuclear, conventional, alliance, and technological systems creating escalation chains	Conventional-nuclear, alliance, technological, and regional entanglement	Crises spread across domains and actors through chain reactions in multipolar systems	NATO nuclear sharing; hypersonics; Quad dynamics; Ukraine war	High unmanaged entanglement destabilizes; managed coordination contains escalation

Source: Authors Compilation

Table 1 represents the four conceptual ideas explored within this paper that exist at various degrees of abstraction, however together they provide an explanation for how nuclear weapons influence Security Dilemma (SD) behaviors in today’s world.

Deterrence Credibility Asymmetry exists at the dyadic level, providing explanations for differences in the ability of states to influence behavior based upon their nuclear threat. This occurs through several mechanisms: Interest Asymmetry (extended deterrence has lower credibility than homeland defense), Capability Asymmetry (the existence of a survivable second strike force enhances credibility), Reputational Asymmetry (exhibited resolve or unpredictability increases the credibility of nuclear threats), Domestic Political Asymmetry (states with stable governments have greater credibility as threatening actors), Technological Asymmetry (advances in Command and Control technologies build trust among potential adversaries). In situations where some or all of these factors support one party in the dyad, that party may deter using fewer resources and/or ambiguous threats, while the party who receives less credible threats will have to spend more money and resources to protect itself and possibly become unpredictable.

Escalation Risk Perception Gaps operate at the cognitive/communicative level and describe how nuclear powers consistently misjudge adversary escalation thresholds. The five types of perception gaps are: threshold perception gaps (misperceptions regarding what constitutes crossing into nuclear territory); Crisis Stability Perception Gaps (disagreements about whether crises can be contained); signaling perception gaps (misinterpreting deterrent signals); Technology Induced Perception Gaps (lack of clarity due to new technologies such as hypersonic missiles); and Cultural Perception Gaps (variations in strategic culture). All of these perception gaps lead to

dangerous misunderstandings where State A's demonstration of resolve is perceived by State B as evidence of State A preparing for attack which leads to unintentionally escalating crises regardless of both sides' preferences for avoiding war.

Second Strike Stability Thresholds also exist at the material/technical level and define the objective physical parameters necessary for achieving a stable condition of nuclear deterrence. There are five requirements for Second Strike Stability: Survivability (second strike forces must remain operational following a first strike via hardened silo's, mobile launch vehicles or ballistic missile submarines); Penetration (second strike forces must successfully penetrate an adversary's missile defense system(s)); Command Survivability (command and control systems must permit a retaliatory response post-attack); Warning Reliability (early warning systems must distinguish between an actual attack and a false alarm with enough time to allow for decision-making); Posture Appropriateness (whether declaratory policy statements such as "no-first-use" affect stability assessments). When a given pair of states meet these conditions, they are mutually vulnerable and therefore SD incentives disappear since neither party can benefit from launching a first-strike attack; however, if either party fails to meet the above conditions, then incentives to launch a first strike begin to develop thereby increasing the intensity of the SD dilemma.

Nuclear Entanglement Cascades exist at the systemic level and explain how crises emanating from one nuclear dyad will rapidly spread to other nuclear dyads through interdependent relations. The four pathways for cascading are: Conventional-Nuclear Entanglements (ambiguous boundaries between conventional and nuclear arms potentially leading to confusion as to whether conventional weapons are intended as part of a nuclear campaign); Alliance Entanglements (commitments made by alliances which link separate dyads, e.g., NATO links U.S.-Russia dyad and Europe's security concerns); Technological Entanglements (interconnected systems used for command and early warning purposes – should failures occur in one dyad they will affect others); Theatrical Entanglements (regional conflicts such as Ukraine/Taiwan involving multiple nuclear powers at once). Each of these pathways creates risk associated with cascading effects whereby a crisis beginning in one dyad will escalate through its connections and lead to conflict in additional dyads originally unaffected by the crisis. Unlike the relative isolationism of bipolarity during the Cold War era, current multipolarities include numerous interlinked relationships thus necessitating a systemic approach to managing stability rather than attempting to manage each dyad individually.

4. Discussion/Findings

4.1. Nuclear Arms and Mutual Vulnerability

The analysis of the examined documents demonstrates that nuclear weapons may contribute to the stabilization of security dilemmas through the condition of mutual vulnerability. However, this stabilizing effect exists only when all parties possess a credible and survivable second-strike capability. If one side doubts its ability to retaliate after absorbing a first strike, the security dilemma intensifies and incentives for pre-emptive behavior increase significantly.

The Cold War relationship between the United States and the Soviet Union illustrates this dynamic most clearly. Once both superpowers developed assured destruction capabilities, strategic

stability increased substantially. McNamara (1968) described this condition as a “balanced terror,” in which neither side could gain a decisive advantage through a surprise attack. Similarly, the SALT I and ABM Treaty documentation explicitly recognized that limiting missile defense systems preserved mutual vulnerability and reduced incentives for first-strike behavior (U.S. Department of State, 1972).

The findings also demonstrate that second-strike stability is not a fixed condition but rather a dynamic and continuously evolving process. Throughout the Cold War, concerns emerged regarding counterforce capabilities, silo vulnerability, and missile defense systems. These concerns generated fears that one side might eventually acquire the ability to neutralize the retaliatory capabilities of the other. Consequently, arms control mechanisms such as SALT II and the INF Treaty were developed to preserve strategic equilibrium.

Contemporary technological developments further complicate this issue. Hypersonic weapons reduce warning times and increase the vulnerability of critical command structures, while cyber capabilities create the possibility of disrupting command-and-control systems before retaliation can occur (Acton, 2018; Sanger, 2018). These developments weaken confidence in second-strike survivability and therefore intensify security dilemma dynamics. The 2022 Nuclear Posture Review similarly acknowledged that emerging technologies may create new risks to strategic stability (U.S. Department of Defense, 2022).

The concept of Second-Strike Stability Thresholds explains these developments. States operating above the threshold experience relatively stable deterrence relationships because neither side expects to benefit from initiating conflict. Conversely, states operating near or below the threshold become increasingly vulnerable to fears of disarming attacks, thereby reinforcing arms races, mistrust, and escalation incentives.

4.2. Emerging Technologies and Strategic Stability

The findings indicate that emerging technologies are fundamentally transforming traditional deterrence relationships and generating new forms of instability. Cyber warfare, hypersonic weapons, artificial intelligence, and advanced missile defense systems collectively reduce decision-making timeframes, increase uncertainty, and create new incentives for pre-emptive action.

Cyber warfare represents one of the most destabilizing developments because it directly threatens nuclear command, control, and communication systems. Official U.S. documents increasingly emphasize the vulnerability of digital infrastructure to cyber disruption (U.S. Department of Defense, 2018). Cyber operations can potentially disable early warning systems, interfere with communication channels, or generate false warning indicators. Such ambiguity increases the probability of miscalculation during crises and complicates efforts to distinguish between espionage, system malfunction, and preparations for attack.

Hypersonic weapons create additional instability by compressing reaction timelines. Unlike traditional ballistic missiles, hypersonic glide vehicles possess unpredictable trajectories and shorter flight durations, thereby reducing opportunities for verification, diplomatic communication, and strategic restraint. As warning times decrease, states may adopt launch-on-

warning postures, which significantly increase escalation risks during crises. Both Russian and Chinese strategic documents present hypersonic systems as responses to U.S. missile defense developments, further intensifying technological competition.

Artificial intelligence introduces a separate category of strategic uncertainty. AI-assisted battle management and decision-support systems may improve operational efficiency but also create risks associated with autonomous escalation and unintended system behavior. The integration of AI into nuclear command systems raises serious concerns regarding human oversight, accountability, and reliability under crisis conditions. The National Security Commission on Artificial Intelligence (2021) warned that AI-enabled systems may unintentionally increase escalation risks through unpredictable outputs and machine-speed decision cycles.

These developments support the concept of Escalation Risk Perception Gaps discussed earlier in this article. States increasingly disagree about the implications of emerging technologies, the thresholds for escalation, and the likely behavior of adversaries during crises. As these perception gaps widen, the probability of accidental or unintended escalation correspondingly increases.

4.3. Regional Nuclear Security Dilemmas

The analysis demonstrates that nuclear proliferation generates regional security dilemmas that differ significantly from the bipolar deterrence structure of the Cold War. Regional nuclear rivalries are characterized by shorter warning times, unresolved territorial disputes, limited communication infrastructure, and less mature command-and-control systems. Consequently, regional deterrence relationships often display greater instability than those observed between the United States and the Soviet Union.

The India–Pakistan dyad provides a particularly important example. Both states possess nuclear capabilities while simultaneously maintaining unresolved territorial disputes and engaging in recurring military crises. The Kargil conflict (1999) and the India–Pakistan standoff (2001–2002) demonstrated that nuclear weapons may prevent full-scale war while simultaneously encouraging lower-level conventional confrontations. This phenomenon reflects the “stability–instability paradox,” in which strategic stability at the nuclear level coexists with instability at the conventional level.

Geographic proximity intensifies these dangers. Missile flight times between India and Pakistan are measured in minutes rather than hours, thereby reducing opportunities for diplomatic intervention and increasing pressures for rapid military responses. The 2019 Balakot crisis demonstrated how quickly regional confrontations can escalate into broader military exchanges involving nuclear signaling and heightened strategic alertness.

The findings also indicate that newer nuclear states frequently lack the sophisticated command-and-control systems developed by older nuclear powers over decades of strategic competition. Concerns regarding unauthorized launch, accidental escalation, and command-chain vulnerability remain significant within regional nuclear environments. These vulnerabilities create additional instability during periods of heightened tension.

The North Korea–United States relationship demonstrates a different form of regional nuclear instability. North Korea relies heavily upon unpredictability and coercive signaling to compensate for its relatively limited nuclear capabilities. The 2017 “Fire and Fury” crisis illustrated how rapidly personality-driven signaling, limited communication infrastructure, and mutual misperceptions can generate dangerous escalation dynamics. The concept of Deterrence Credibility Asymmetry is particularly relevant in this context because North Korea attempts to compensate for material inferiority through reputational unpredictability and perceived willingness to escalate.

Overall, the findings demonstrate that regional nuclear dilemmas cannot be managed effectively through generalized Cold War deterrence models. Each regional environment possesses unique geographic, political, technological, and organizational characteristics requiring tailored approaches to crisis management and strategic stability.

4.4. Arms Control Erosion and Transparency Loss

The analysis of strategic arms control agreements demonstrates that transparency mechanisms have historically played a central role in reducing uncertainty and limiting the intensity of security dilemmas. However, the erosion of contemporary arms control architecture has significantly weakened transparency and increased worst-case strategic assumptions among nuclear powers.

The collapse of the INF Treaty in 2019 represents a particularly important turning point. The treaty eliminated an entire category of intermediate-range missile systems and reduced instability by increasing warning times and limiting surprise attack capabilities. Following the treaty’s collapse, both the United States and Russia accused each other of violations, while concerns emerged regarding the deployment of new missile systems capable of reducing strategic warning periods.

Similarly, uncertainty regarding the future of the New START Treaty has intensified concerns about transparency and predictability. New START established limits on deployed strategic warheads and created verification mechanisms including inspections, notifications, and data exchanges. These mechanisms reduced uncertainty regarding force structures and modernization programs. Without such mechanisms, states become increasingly dependent upon intelligence estimates and worst-case assumptions when evaluating adversary capabilities.

The absence of formal arms control dialogue between the United States and China further contributes to instability. Chinese nuclear modernization programs, including the development of mobile intercontinental ballistic missiles and sea-based nuclear systems, have generated growing concern within U.S. strategic assessments. At the same time, China has resisted participation in formal arms control negotiations, arguing that such agreements could undermine its national security interests.

The findings indicate that transparency erosion is destabilizing because it undermines confidence in second-strike survivability and increases fears regarding adversary intentions. In the absence of reliable information, states tend to assume worst-case scenarios and respond through

military modernization, force expansion, and technological competition. These reciprocal actions intensify security dilemma dynamics and increase the probability of future crises.

4.5. Path Dependence in Crisis Stability

The findings demonstrate that crisis stability exhibits strong path dependence. Previous crises, institutional memory, communication mechanisms, and historical experiences significantly shape how nuclear powers interpret and respond to future confrontations.

The U.S.–Soviet relationship during the Cold War illustrates how repeated crises contributed to the gradual development of crisis management infrastructure. The Cuban Missile Crisis led directly to the establishment of the Washington–Moscow hotline and encouraged both superpowers to develop procedures for communication, signaling, and de-escalation. Subsequent crises reinforced institutional learning and generated additional confidence-building mechanisms such as the Incidents at Sea Agreement and the Nuclear Risk Reduction Centers.

Repeated interaction allowed both sides to develop greater understanding of each other’s escalation thresholds, strategic cultures, and signaling behaviors. Although Cold War crises remained dangerous, institutionalized communication mechanisms reduced uncertainty and helped limit the risk of unintended escalation.

In contrast, the India–Pakistan relationship demonstrates more negative forms of path dependence. Repeated crises have reinforced mutual distrust while failing to generate durable communication infrastructure comparable to Cold War confidence-building mechanisms. Each confrontation creates new precedents for escalation without producing equivalent institutional learning regarding restraint and crisis management.

The North Korea–United States dyad exhibits even weaker forms of positive path dependence because of limited historical interaction, inconsistent diplomatic engagement, and the absence of stable communication channels. Each crisis therefore occurs within a relatively isolated political context, limiting opportunities for cumulative learning and increasing the probability of repeated misperceptions.

The concept of Escalation Risk Perception Gaps helps explain these patterns. Repeated interaction and institutional memory reduce perception gaps by improving understanding of adversary behavior and escalation thresholds. Conversely, the absence of communication infrastructure and stable diplomatic interaction preserves ambiguity and increases crisis instability.

Overall, the findings demonstrate that strategic stability depends not only upon material military capabilities but also upon institutionalized communication, accumulated experience, and mutual understanding developed over time.

5. Implications for International Security

5.1. Strategic Stability Requires Reinvigorated Arms Control Adapted to Contemporary Conditions

The findings of this study demonstrate that strategic stability can no longer rely exclusively on Cold War assumptions regarding deterrence, transparency, and mutual vulnerability. The

erosion of traditional arms control agreements, combined with the emergence of new technologies and multipolar competition, has generated a strategic environment characterized by increased uncertainty, reduced predictability, and heightened escalation risks.

Traditional arms control frameworks were designed primarily to regulate the quantity of nuclear warheads and delivery systems. Contemporary strategic realities require broader approaches capable of addressing cyber warfare, hypersonic weapons, artificial intelligence, missile defense systems, and dual-use technologies that blur the distinction between conventional and nuclear capabilities. Existing agreements are insufficient to manage these emerging sources of instability.

The weakening of verification mechanisms has particularly serious implications for international security. Verification systems historically reduced worst-case assumptions by providing transparency regarding force deployments, modernization programs, and military intentions. As transparency declines, states increasingly rely upon intelligence estimates and adversarial assumptions, thereby reinforcing security dilemma dynamics and accelerating arms competition.

The findings also indicate that future strategic stability frameworks must become more inclusive. Cold War arms control operated largely within a bipolar U.S.–Soviet framework, whereas the contemporary international system is increasingly multipolar. China’s expanding nuclear modernization, regional nuclear powers, and interconnected alliance structures require broader mechanisms capable of addressing multiple nuclear actors simultaneously. Failure to adapt arms control institutions to contemporary realities will likely increase instability across multiple regional and global security environments.

5.2. Emerging Technologies Require New Governance Frameworks Beyond Traditional Deterrence Theory

The research demonstrates that emerging technologies are transforming the fundamental assumptions underlying classical nuclear deterrence theory. Technologies such as cyber warfare, artificial intelligence, hypersonic weapons, autonomous systems, and advanced missile defense capabilities are compressing decision timelines, increasing ambiguity, and creating escalation pathways that traditional deterrence models were not designed to address.

Cyber operations represent a particularly destabilizing challenge because they undermine confidence in nuclear command, control, communication, and early warning systems. Unlike traditional military capabilities, cyberattacks are often difficult to attribute and may remain undetected until systems fail during crises. This ambiguity creates uncertainty regarding adversary intentions and increases the probability of miscalculation.

Similarly, hypersonic weapons destabilize strategic relationships by reducing warning times and limiting opportunities for diplomatic communication during crises. The inability to distinguish rapidly between conventional and nuclear payloads further intensifies escalation risks. Artificial intelligence introduces additional uncertainty because automated systems may produce unpredictable outcomes during high-pressure strategic situations.

These developments demonstrate that traditional deterrence theory, which assumed relatively stable communication, rational decision-making timelines, and identifiable military actions, must be substantially revised. International security increasingly depends not only upon balancing military capabilities but also upon regulating technological interactions, preserving human oversight, and developing mechanisms capable of managing ambiguity and rapid escalation dynamics.

The findings therefore suggest that future international security governance must extend beyond classical arms control and incorporate technological governance frameworks specifically designed for multidomain deterrence environments.

5.3. Regional Nuclear Dilemmas Require Tailored Security Approaches

The analysis demonstrates that regional nuclear rivalries exhibit significantly different characteristics than the bipolar U.S.–Soviet rivalry that shaped much of classical deterrence theory. Consequently, generalized Cold War deterrence models are insufficient for managing contemporary regional nuclear crises.

Regional nuclear environments are often characterized by unresolved territorial disputes, short missile flight times, limited crisis communication infrastructure, and varying levels of command-and-control maturity. These conditions create higher levels of instability and increase the probability of rapid escalation during military confrontations.

The India–Pakistan rivalry illustrates how nuclear weapons may simultaneously prevent large-scale war while encouraging limited conventional conflicts under the assumption that nuclear deterrence will prevent full escalation. Similarly, the North Korea–United States relationship demonstrates how asymmetrical capabilities and unpredictable signaling can generate instability despite overwhelming differences in military power.

The findings also indicate that regional strategic cultures significantly influence deterrence behavior. States differ in their interpretations of escalation thresholds, acceptable risk, signaling practices, and military doctrine. These differences create escalation risk perception gaps that cannot be understood solely through material force comparisons.

Therefore, effective international security management requires region-specific approaches tailored to local political, geographic, technological, and organizational conditions. Crisis management mechanisms, communication systems, confidence-building measures, and strategic dialogue must be adapted to the unique dynamics of each regional nuclear environment rather than imposed through universal deterrence frameworks.

5.4. Systemic Stability Has Become More Important Than Dyadic Stability

One of the most important implications of this research is that international security can no longer be understood exclusively through isolated dyadic deterrence relationships. Contemporary nuclear stability increasingly depends upon the management of interconnected strategic systems involving multiple states, alliances, technologies, and military domains simultaneously.

The concept of Nuclear Entanglement Cascades demonstrates that crises originating within one regional or bilateral confrontation may rapidly spread through alliance commitments,

technological interdependencies, or multidomain military operations. Conventional conflicts now possess greater potential to trigger nuclear signaling, while cyber incidents or technological failures may unintentionally generate escalation across multiple strategic environments.

Alliance structures further complicate strategic stability because commitments made within one regional context may involve additional nuclear powers indirectly connected to the original dispute. NATO commitments, U.S. alliances in the Indo-Pacific region, and strategic partnerships among regional nuclear states create overlapping deterrence relationships that increase systemic complexity.

The findings suggest that future international security frameworks must focus not only upon managing individual deterrence relationships but also upon strengthening systemic resilience across interconnected strategic environments. This includes improving cross-domain communication mechanisms, enhancing transparency between alliances, reducing technological ambiguity, and developing institutional mechanisms capable of preventing escalation cascades.

Ultimately, maintaining strategic stability in the contemporary era requires a transition from narrowly defined bilateral deterrence management toward broader systemic approaches capable of addressing the realities of an increasingly interconnected and technologically complex multipolar world.

6. Policy Recommendations

6.1. Extend New START and Initiate a Broader Strategic Stability Framework

The findings of this study indicate that preserving transparency and predictability among major nuclear powers remains essential for maintaining strategic stability. Therefore, extending the New START Treaty should be treated as an immediate international security priority. The continuation of verification measures, inspections, and data exchange mechanisms would reduce uncertainty regarding strategic force modernization and prevent the intensification of worst-case strategic assumptions.

However, extending New START alone will not be sufficient to address contemporary strategic realities. Future negotiations should seek to establish a broader strategic stability framework that includes not only deployed strategic warheads but also non-strategic nuclear weapons, hypersonic systems, missile defense capabilities, and selected emerging technologies that influence escalation dynamics.

The study further demonstrates the growing importance of China within the global nuclear balance. Consequently, strategic stability dialogues involving the United States, Russia, and China should be initiated as early as possible. Although formal trilateral arms control agreements may not yet be politically feasible, confidence-building measures, transparency initiatives, and crisis communication arrangements could substantially reduce uncertainty and escalation risks within the evolving multipolar environment.

In addition, verification mechanisms should be modernized to address the realities of mobile launch systems, dual-use technologies, cyber capabilities, and multidomain military infrastructure.

Without updated verification procedures, future arms control agreements will struggle to maintain credibility and effectiveness.

6.2. Establish International Norms for Emerging Technologies

Emerging technologies are increasingly undermining traditional deterrence stability by generating ambiguity, compressing decision-making timelines, and creating new escalation pathways. The findings therefore indicate an urgent need for international governance frameworks specifically designed to regulate the strategic implications of cyber warfare, hypersonic weapons, and artificial intelligence in military systems.

In the cyber domain, states should develop agreements prohibiting attacks against nuclear command, control, communication, and early warning systems. Cyber operations targeting such infrastructure create severe risks of accidental escalation and misinterpretation during crises. Confidence-building measures should include mandatory notification procedures for large-scale cyber exercises and mechanisms for rapid consultation regarding ambiguous cyber incidents.

Regarding hypersonic weapons, transparency measures should be introduced to reduce uncertainty concerning operational deployment and strategic intentions. Such measures may include pre-notification of hypersonic missile tests, exchanges of technical information regarding capabilities, and discussions concerning operational limitations similar to previous intermediate-range missile agreements.

Artificial intelligence requires particularly careful regulation due to its potential role within strategic decision-making systems. International agreements should preserve meaningful human control over all decisions involving nuclear weapons employment. Autonomous launch authority should remain prohibited, and states should establish common standards regarding human oversight, accountability, and verification procedures for AI-assisted military systems.

The development of international technological norms would not eliminate competition among states, but it could significantly reduce ambiguity and improve predictability within increasingly complex deterrence environments.

6.3. Strengthen Regional Crisis Management Infrastructure

The research demonstrates that regional nuclear rivalries possess unique characteristics that require tailored crisis management mechanisms adapted to local conditions. Consequently, international security policy should prioritize the development of region-specific communication infrastructure, confidence-building measures, and de-escalation procedures.

In South Asia, additional communication channels between India and Pakistan are urgently needed. Existing hotline arrangements should be expanded and modernized to include secure real-time communication capabilities capable of functioning during military crises. Furthermore, both states should establish formal notification mechanisms regarding missile tests, military exercises, and major troop movements in order to reduce the risk of misinterpretation.

Regular bilateral crisis management exercises involving civilian and military officials could improve mutual understanding of escalation thresholds and decision-making procedures.

Confidence-building measures concerning border incidents and airspace violations would also contribute to reducing instability during periods of heightened tension.

In Northeast Asia, the absence of stable communication channels involving North Korea remains a major source of strategic instability. International actors should therefore support the establishment of permanent crisis communication mechanisms capable of functioning independently of temporary political conditions. Third-party intermediaries or multilateral organizations may play an important role in facilitating such communication.

The findings further suggest that regional security frameworks should incorporate not only military dimensions but also diplomatic, informational, and technological components capable of addressing multidomain escalation dynamics.

6.4. Preserve Meaningful Human Control and Enhance Systemic Stability Mechanisms

The growing integration of artificial intelligence, automated systems, and multidomain military infrastructure into nuclear decision-making processes creates significant risks associated with unintended escalation and systemic instability. Consequently, preserving meaningful human control over nuclear weapons systems must become a central principle of contemporary strategic policy.

National governments should establish explicit legal and doctrinal limitations prohibiting autonomous nuclear launch decisions by artificial intelligence systems. Human authorization must remain mandatory for all decisions involving the use of nuclear weapons. Military organizations should additionally implement rigorous safeguards designed to prevent unintended escalation resulting from automated system malfunction, algorithmic error, or cyber manipulation.

The findings also demonstrate that strategic stability increasingly depends upon the resilience of interconnected international systems rather than solely upon isolated bilateral deterrence relationships. Therefore, states should strengthen systemic stability mechanisms capable of managing escalation across multiple alliances, domains, and regional crises simultaneously.

Such mechanisms should include regular multilateral strategic stability dialogues, expanded communication networks among nuclear powers, and institutionalized crisis consultation procedures capable of functioning during periods of heightened geopolitical tension. Particular attention should be devoted to improving transparency regarding multidomain military operations that combine cyber, conventional, space, and nuclear capabilities.

Finally, international organizations and strategic institutions should promote shared understandings regarding escalation thresholds, emerging technologies, and crisis management practices. Reducing uncertainty and improving communication remain among the most effective tools for preventing unintended escalation within an increasingly interconnected multipolar nuclear environment.

7. Conclusion

The security dilemma and nuclear deterrence are still at the forefront of international security issues today; however, there is an enormous difference between the contemporary conditions and those during the Cold War that deterrence theory was formulated.

This article introduces four novel theoretical concepts: Deterrence Credibility Asymmetry, Escalation Risk Perception Gaps, Second Strike Stability Thresholds, and Nuclear Entanglement Cascades) to understand the dynamics of nuclear security dilemma in the context of modern conditions.

Qualitative document analysis of 50 documents over eighty years of nuclear history provided us with five major findings. Findings indicate that nuclear weapons may alleviate security dilemmas due to mutual vulnerability; however, the extent of this effect relies heavily on second strike capabilities and is decreasing due to technological advancements. Additionally, emerging technologies such as cyber warfare, hypersonic missiles, and AI systems are destabilizing traditional deterrence relationships. Proliferation of nuclear weapons to additional countries creates regional security dilemmas that exhibit unique dynamics compared to great power rivalries. Erosion of arms control agreements has caused decreased transparency and increased uncertainty, which results in worse-case assumptions that create vicious cycles within the security dilemma. Crisis stability also exhibits path dependence, where previous engagements create escalated risk in future crises.

These findings have substantial implications for international security. Re-establishing strategic stability will depend upon renewed and adaptive arms control agreements consistent with the modern environment. In order to govern emerging technologies beyond traditional arms control, new frameworks are required. Tailored approaches are necessary to manage regional nuclear dilemmas, rather than utilizing generic deterrent models. Finally, managing entangled nuclear systems will require systemic level stability management, rather than just dyadic level.

Some policy recommendations include extending the New START agreement and beginning US-China strategic stability talks, developing norms and confidence-building measures for governing emerging technologies, creating regional crisis management infrastructure for South Asia and Northeast Asia, and maintaining a degree of meaningful human control while establishing systemic stability mechanisms.

Transition to a new nuclear era will necessitate continued diplomatic efforts, innovative institutions, strategic restraint, and awareness of how contemporary conditions differ from Cold War analogies. While nuclear weapons are unlikely to become obsolete, their destabilizing influence can be managed through open communication channels and verifiable agreements that demonstrate mutual understanding of escalation risks, as well as institutionalized crisis management mechanisms. The theories and empirical data collected throughout this article serve as analytic tools to facilitate this crucial process.

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