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On the Horizon

A Collection of Papers from the Next Generation

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A Report of the
CSIS PROJECT ON NUCLEAR ISSUES

CSIS | CENTER FOR STRATEGIC & INTERNATIONAL STUDIES

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About the Project on Nuclear Issues

The Project on Nuclear Issues (PONI) was developed in 2003 to develop the next generation of policy, technical, and operational nuclear professionals by fostering, sustaining, and convening a networked community of emerging experts. PONI identifies and cultivates emerging thought leaders by building relationships, deepening understanding, and sharing perspectives across the full range of nuclear issues and communities. PONI's programs provide inclusive, diverse, and creative opportunities for rising experts to learn about policy, technical, and operational aspects of the nuclear community, develop and present new concepts and ideas, engage in thoughtful and informed debates, and tour and visit sites across the nuclear enterprise.

PONI strives to achieve this mission through several objectives:

- identifying emerging thought leaders and providing them with the opportunity to develop and present new concepts and ideas;
- sponsoring new cutting-edge research;
- encouraging thoughtful and informed debate;
- engaging a broad and diverse community across the country and internationally;
- providing a networked platform for information-sharing and collaboration across the broad nuclear community; and
- cultivating young professionals through opportunities to build relationships, deepen understanding, and share perspectives across the full range of nuclear issues and communities.

PONI sponsors numerous opportunities for young professionals to engage in thoughtful and informed debate on the nuclear community's most pressing challenges.

PONI strives to expand its outreach to address all career and academic levels, connect young professionals in collaborative research projects, broaden the topics it covers across the full spectrum of nuclear issues, and ensure robust inclusion of expertise from all critical domains—academic, military, scientific, and technical. PONI's approach to this project includes three core goals:

1. **Inclusivity**: PONI welcomes all ideas and perspectives across political, ideological and policy spectrum.
2. **Diversity**: PONI actively seeks interdisciplinary perspectives across technical, operational, corporate, government, academic backgrounds and embraces participation across all demographics.

3. **Creativity**: PONI promotes collaborative, innovative research and dynamic, engaging programming.

Among the various programming opportunities available through PONI, the authors in this publication were members of PONI's 2021 Nuclear Scholars Class. The PONI Nuclear Scholars Initiative is a group of select graduate students and young professionals. The initiative aims to provide top graduate students and young professionals from around the country with a unique venue to interact and hold dialogue with senior experts on nuclear weapons issues. Those accepted into the program are hosted monthly at CSIS in Washington, D.C., where they participate in day-long workshops with senior government officials and policy and technical experts. Over the course of the six-month program, PONI Nuclear Scholars are required to prepare a research product. PONI has several alumni from this initiative, many of whom continue to work in the nuclear field and play key roles in nuclear policy development, technical innovations, and operations.

Acknowledgments

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Contents

Introduction

By Doreen Horschig

Over the past year, the nuclear community has faced numerous challenges. The ongoing conflict resulting from Russia's invasion of Ukraine has created a protracted and devastating situation, leading to a renewed emphasis on the salience of nuclear weapons in defense strategies. Meanwhile, China is doubling the size of its nuclear arsenal, and emerging nuclear powers like North Korea and Iran are testing the robustness of international norms. This pivotal moment is marked by a complex interplay of factors across multiple domains, the integration of emerging technologies, and the intensification of nuclear rhetoric. However, it has also sparked a resurgence in nuclear intellectual exploration.

There is now a consensus, driven by an intensified sense of urgency, that a profound depth of knowledge and unwavering commitment is essential to address current and future nuclear challenges. Meeting these challenges will necessitate a sustained, long-term endeavor involving diverse, multidisciplinary, and emerging voices of nuclear experts. These experts must possess the critical knowledge, skills, and a robust professional network to address the political, military, legal, ethical, and technical challenges in the United States and worldwide that will require innovative and multifaceted approaches.

Recognizing this challenge, the Center for Strategic and International Studies (CSIS) launched the Project on Nuclear Issues (PONI) in 2003 to develop the next generation of policy, technical, and operational nuclear professionals by fostering, sustaining, and convening a networked community of emerging experts. PONI seeks to revitalize and strengthen the community of nuclear experts whose training and background increasingly emphasize multidisciplinary expertise, especially among young generations. PONI runs two signature programs for young professionals—the Nuclear Scholars Initiative and the Annual Conference Series—to engage rising nuclear experts in thoughtful and informed debate on how to best address the nuclear community's most critical issues. This volume is comprised of papers from participants in the 2023 Nuclear Scholars Initiative. PONI sponsors this research to provide a forum for facilitating new and innovative thinking and providing a platform for fresh thought leaders across the nuclear enterprise. Through a process of peer review, mid-career mentorship, and senior expert review, nuclear scholars are encouraged to immerse themselves in tough questions that we do not yet know the answers to. The papers in this volume span a wide range of policy and technical issues, invite discussion in their respective areas, and provide innovative recommendations for current challenges. To that end, these papers explore the impact

on the war in Ukraine on nuclear dynamics, the influence of emerging and disruptive technologies on nuclear decisionmaking and public perceptions, and the visible changes in nuclear arsenals and strategies in a number of nuclear weapons states. There is something in this volume for everyone in the nuclear community. That is PONI's mission.

Reflections and Revelations from the Russia-Ukraine War

Unconventional Pathways to Stability

Informal Agreements in the Post–New START Landscape

By Matthew Hartwell[1]

What steps should the United States take to prevent nuclear arms racing in a world without formal arms control agreements? The possibility of a New START follow-on is becoming increasingly unlikely as Russia ties advancement in negotiations to U.S. support for Ukraine. Despite the current limitations on progress in formal arms control, there is a possible route to maintain stability by preserving the essential feature of New START: keeping strategic nuclear forces at a fixed level. This paper proposes that the United States should seek to establish an informal arms control framework before New START expires in February 2026.

On February 21, 2023, in a state-of-the-nation address to the Russian Federal Assembly, President Vladimir Putin announced that Russia was "suspending its participation" in New START until the United States stopped funding the Ukrainian war effort and included the United Kingdom and France in future talks.[2] This ambiguous announcement was the latest of a series of moves to push back against provisions within the treaty following Russia's invasion of Ukraine. The first development occurred in August 2022, when Russia indefinitely suspended on-site inspections. While this had originally been mutually agreed upon due to Covid-19 precautions, a foreign ministry statement linked the suspension to inspectors' difficulty traveling to the United States due to Russian sanctions.[3] In November 2022, Russia announced that it would postpone participation in New START's

1 Matthew Hartwell is a PhD candidate in international relations at American University's School of International Service and a research associate with the Project on Managing the Atom and the Center for Security, Innovation, and New Technology.

2 Shannon Bugos, "Russia Suspends New START," Arms Control Association, March 2023, https://www.armscontrol.org/act/2023-03/news/russia-suspends-new-start.

3 "Lavrov says US wants New START Treaty inspections to resume but isn't ready to play fair," TASS, December 28, 2022,

Bilateral Consultative Commission, a venue to discuss implementation and verification concerns. Russian deputy foreign minister Sergei Ryabkov linked this decision to the war in Ukraine, stating that arms control is not "immune" to world events.[4]

A formal treaty with comparable provisions to New START would present the United States with two benefits. The New START Treaty introduced a level of verification that allowed for significant strategic certainty, and the system of on-site inspections and venues for dialogue provided a valuable route to assess compliance. However, the current situation does not fare well for a New START follow-on. Even if there were sufficient time for the United States and Russia to agree to a New START follow-on, a president would be unlikely to be able to gather the sufficient two-thirds vote in the Senate necessary for ratification. An executive agreement could bypass some aspects of the domestic barriers to a New START follow-on, but strong congressional resistance could affect attempts to implement the treaty's provisions, generating mistrust and damaging the agreement's legitimacy.

The United States should establish an informal arms control framework before the treaty expires. There are two reasons to believe that such an informal agreement, focused on maintaining New START force levels, could succeed. Even if Russia refuses to sign a formal treaty, it has economic and strategic incentives to avoid an arms race. Moreover, there are historical precedents for informality and reliance on national technical means, the main components of this approach. Nonetheless, an informal arrangement is not a complete solution. The limits to verification relying purely on national technical means and potential congressional resistance offer two evident threats that increase the uncertainty of an informal arrangement. Therefore, this research also explores potential issues with the arrangement and proposes some practical solutions to address these potential spoilers.

RATIONALE AND PRECEDENTS FOR RESTRAINT

The recent shifts in Russian compliance have been sufficient to weaken the treaty without bringing it to a breaking point. Russia's refusal to engage in the two key elements of the New START Treaty outlined in the previous section puts it in a non-compliant position. In its annual Report to Congress on the Implementation of the New START Treaty in January 2023, the U.S. Department of State found that Russia was failing to comply with the treaty due to its unwillingness to reschedule the Bilateral Consultative Commission meeting within the period set out in the treaty, as well as its refusal to permit on-site inspections.[5]

Despite these evident issues, Russia's actions have been ambiguous. Immediately following Putin's February announcement, deputy foreign minister Ryabkov clarified that Russia would remain within the treaty limits and continue to notify the United States regarding missile launches.[6] Furthermore, there is little evidence that Russia plans to immediately move beyond the New START limits in the near future. These actions suggest a political motive for Russian behavior.

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https://tass.com/politics/1557031. Similarly, Russian foreign minister Sergey Lavrov blamed this on the lack of mutual trust caused by the United States branding Russia as the enemy.

4 Shannon Bugos, "Russia Delays Meeting on New START," Arms Control Association, December 2022, https://www.armscontrol.org/act/2022-12/news/russia-delays-meeting-new-start.

5 "Report to Congress on Implementation of the New START Treaty," U.S. Department of State, January 2023, https://www.state.gov/wp-content/uploads/2023/01/2022-New-START-Implementation-Report.pdf.

6 François Diaz-Maurin, "Three Ways the US Should Respond to Russia's Suspension of New Start," Bulletin of the Atomic Scientists, April 25, 2023, https://thebulletin.org/2023/03/three-ways-the-us-should-respond-to-russias-suspension-of-new-start/.

There are strategic and economic reasons why Russia could demonstrate restraint after the end of New START. In simple terms, this possibility for restraint stems from the benefits offered by arms control. The United States and Soviet Union found pursuing arms control beneficial even in periods of intense competition over the Cold War. Rather than a pathway to disarmament, arms control agreements have provided more modest goals: bolstering strategic stability, aiding in risk reduction, and increasing transparency. Russia's decision to comply with the most important element of New START—maintaining stable levels of strategic offensive arms—demonstrates that it may continue to see the benefits offered by the agreement.

The military failure in Ukraine will force Russia to rebalance its limited economic capabilities to address evident conventional deficiencies. The possibility of an overwhelming Russian military breakthrough or negotiated peace would speed up this process. But the most likely option, a protracted crisis, would delay any attempts to deal with the evident issues.[7] Conventional rebuilding will lead to difficult choices. It is questionable whether Russia would be financially capable of devoting significantly more resources to pursue nuclear superiority over the United States while simultaneously rebuilding and strengthening its conventional forces amid Western sanctions. These factors do not preclude the possibility that Russia will be unwilling to test New START limits in the next few years. However, taking the necessary long-term, expensive, and destabilizing steps toward an arms race with the United States is a qualitatively different step.

Beyond strategic and economic incentives for remaining within New START limits, there is important historical evidence for successful informal arms control arrangements. The SALT II treaty is a critical example of informal stability. The agreement, the second in a set of international treaties stemming from the Strategic Arms Limitation Talks between the United States and Soviet Union, was formalized in June 1979. The treaty agreed to continue the measures stemming from a first round of talks, called the Interim Agreement. It also introduced further limits and reductions on the strategic arsenals of both sides. However, this agreement was signed just six months before the Soviet invasion of Afghanistan, and President Jimmy Carter subsequently withdrew the treaty from consideration in the Senate.[8] While the incoming president, Ronald Reagan, frequently spoke out against the agreement, describing it as "fatally flawed," he chose a policy of abiding by the treaty as long as the Soviet Union demonstrated comparable restraint.[9] Both sides followed the terms of SALT I, which expired in 1977, and SALT II until 1986, one year after the sunset clause.[10]

On the issue of verification, again, there are important historical precedents for an informal approach. Considering the Russian state's unwillingness to adhere to the on-site verification over the last three years, it could be necessary to focus on less intrusive methods of verification to ensure the primary goal of stability. By focusing simply on force levels, stability would need to be modeled on an informal verification system based on national technical means. The term originated in the 1972 Anti-Ballistic Missile Treaty, and similar language was included in the two follow-up treaties, the 1977 SALT I Interim Agreement and the SALT II treaty. Despite some variation in language, this verification system has primarily been based upon mutual restraint, with both sides foregoing

7 Moreover, the war has demonstrated evident issues with logistics, maintenance, and training—deeper issues that require long-term systematic reorganizations.

8 Anna Schumann, "Strategic Arms Limitation Treaty II," Center for Arms Control and Non-Proliferation, May 19, 2023, https://armscontrolcenter.org/strategic-arms-limitation-treaty-ii/.

9 Charlotte Saikowski, "Understanding the Forces behind the SALT II Controversy," *Christian Science Monitor*, June 4, 1986, https://www.csmonitor.com/1986/0604/asumm.html.

10 Schumann, "Strategic Arms Limitation Treaty II."

attempts to either interfere with or impede the other side's pursuit of verification, for example, through deliberate concealment. While New START went well beyond relying on national technical means, most Cold War–era agreements depended on this system as the key means of verification.[11]

POTENTIAL INTERNATIONAL SPOILERS

THE LIMITS TO NATIONAL TECHNICAL MEANS

Reliance on national technical means is a step down in verification provisions compared to those under New START. There are undeniable strategic limitations to such an approach. Without a New START–type verification system, reliance on national technical means provides less certainty on accurate force levels. Previous arms control agreements utilizing national technical means as a verification system have been predicated upon the principle of mutual noninterference. This situation could continue following the expiration of New START. However, formal prohibitions on interference will expire with the treaty. Therefore, either side could decide that restraint is not in their interests.[12] While the United States maintains an impressive capability to monitor Russian force levels, on-site inspections offer a more valuable route to monitor potential violations. Without the detailed verification system in New START, the potential for cheating could undermine transparency, provoke a further decline in U.S.-Russia relations, and create incentives for arms racing.

Despite the limitations to relying on national technical means, if one were to assume that Russia was willing to remain within the New START limits, there may be routes to decrease the uncertainty associated with this approach. The most important issue concerns the mutual restraint on interfering with national technical means. One critical way to build confidence in national technical means would be to gain explicit assurances that both sides remain committed to this principle. Considering the state of U.S.-Russian relations, it seems unlikely that either side would accept a formal noninterference agreement. While a global treaty in this area is an important long-term goal, a temporary stopgap—an informal agreement to abide by the mutual restraint outlined in New START—would address the most critical issue.

The second route to decrease uncertainty—reintroducing the data transfers and forums for communication under New START—is a less certain endeavor. As discussed before, Russia has increasingly abandoned these important measures since the beginning of the war in Ukraine. Nevertheless, the United States could create avenues for communication to decrease the uncertainty associated with relying on national technical means. While the more intrusive measures under New START may be infeasible, the United States should seek areas where Russia could be willing to engage, such as risk reduction measures and force declarations. Moreover, the United States should utilize alternative forums for communication outside of the New START process. One alternative option would be to try and revive the Strategic Stability Dialogue. Alternatively, the P5 process, a route that would meet Russian demands for multilateralism, could be a more fruitful pathway to communication.

CONGRESSIONAL RESISTANCE

Removing arms control from the domestic realities in the United States is impossible. Within formal arms control agreements, Congress had two main roles. First, the Senate maintains the

11 Amy F. Woolf, *The Past and Future of Bilateral Nuclear Arms Control* (Geneva: UN Institute for Disarmament Research, March 2023), https://doi.org/10.37559/WMD/23/DDAC/01.

12 Theresa Hitchens, "US Missile Warning Sats Fair Game If No New Start?," Breaking Defense, July 22, 2021, https://breakingdefense.com/2019/07/us-missile-warning-sats-fair-game-if-no-new-start/.

power to ratify treaties. Members can reject the agreement or demand concessions in exchange for their vote with this leverage. Second, even in cases where an administration introduces a treaty as an executive agreement, ratification may still need legislative majorities, as there are still routes through which Congress can make its voice heard, such as blocking funding necessary to implement the treaty provisions.[13]

In the context of informal arms control, the importance of congressional resistance is more difficult to predict. Perhaps the most important historical precedent for this resistance is the congressional response to the Joint Comprehensive Plan of Action. In this case, the decision to pursue an executive agreement cut some of the power of Congress. However, groups opposed to the agreement mobilized and attacked the deal from other angles. This effort included wide-scale lobbying to challenge the treaty in Congress and within the media. Opponents used various aspects of congressional power, for example, sanctions on Iran, as a route to undercut the deal through alternative political pathways. In short, even when opponents in Congress do not have complete control over executive-level foreign policy, they have alternative routes to challenge informal arms control agreements.

Congress could challenge an informal arms control arrangement in three significant areas. Opponents could use their considerable platform to mobilize support to challenge the treaty in and outside of Congress.[14] Moreover, members of Congress have alternative tools unrelated to arms control, for example, sanctions, to undermine U.S.-Russia relations.[15] Congressional members could also use the power of the purse to increase defense budgets well beyond the administration's request.[16] On its own, if sufficiently threatening, this final option could be enough to lead to a Russian response to move beyond New START limits. However, as outlined at the start of this paper, there is evidence that Russia views arms control as firmly embedded in wider U.S.-Russia relations. Therefore, congressional measures to challenge Russia's security, broadly defined, could have a knock-on effect on an informal arms control agreement, even if the actions were not directly related to nuclear forces under New START.

The ratification of New START provides important lessons to address these issues. To soften domestic opposition to the treaty, the Obama administration introduced generous concessions on weapons and infrastructure modernization to assuage congressional concerns. While the power of Congress in an informal arms control agreement would be limited compared to New START, Congress could still make its voice heard. To ensure that domestic spoilers cannot weaken any informal arms control arrangements, the Biden administration should identify potential payoffs to keep a level of congressional acquiescence for an informal arrangement. Like congressional efforts to override the administration's budget request, these payoffs could undermine Russian security interests, generate mistrust, and create incentives for breakout. Therefore, ensuring that payoffs do not focus on historical areas of U.S.-Russia tension, for example, missile defense, could be one way to meet domestic demands in Congress without creating the conditions for arms-racing behavior.

13 Sarah E. Kreps, Elizabeth N. Saunders, and Kenneth A. Schultz, "The Ratification Premium," *World Politics* 70, no. 4 (2018): 479–514.

14 "Thousands Pack New York's Times Square to Protest Iran Nuclear Deal with US," *The Guardian*, July 23, 2015, https://www.theguardian.com/world/2015/jul/23/thousands-pack-times-square-protest-iran-nuclear-deal-us; and "Trump storms Washington," *Politico*, September 9, 2015, https://www.politico.com/story/2015/09/donald-trump-iran-deal-washington-rally-213451.

15 Michael Crowley, Philip Gordon, and John Bresnahan, "The second dispute with Congress that could derail Obama's Iran deal," *Politico*, December 8, 2015, https://www.politico.com/story/2015/08/us-iran-deal-obama-tehran-sanctions-121295.

16 Shannon Bugos, "Congress Boosts Defense Budget Beyond Biden's Request," Arms Control Association, January 2023, https://www.armscontrol.org/act/2023-01/news/congress-boosts-defense-budget-beyond-bidens-request.

POSSIBILITIES FOR RESTRAINT AFTER NEW START

The current international situation does not bode well for a New START follow-on agreement. A world without formal arms control agreements would increase uncertainty and generate significant pressure for either side to break out of the soon-to-be-defunct strategic force limits. The potential consequences of an arms race between these two nations, possessing the world's largest nuclear arsenals, are significant and alarming. As Matt Korda outlined in a recent article, both sides can essentially double the size of their strategic nuclear forces if they "uploaded their delivery systems to accommodate the maximum number of possible warheads."[17] However, without formal arms control agreements, there are still avenues for maintaining strategic stability and preventing an arms race. Informal arms control offers a viable alternative to maintain New START force levels. This approach has evident issues, and informal arms control requires measures to increase strategic certainty and assuage domestic concerns. This research has sought to identify potential domestic and international spoilers to an informal arrangement and provides possible routes to bolster an informal arms control arrangement.

17 Matt Korda, "If Arms Control Collapses, US and Russian Strategic Nuclear Arsenals Could Double in Size," Federation of American Scientists, May 9, 2023, https://fas.org/publication/if-arms-control-collapses-us-and-russian-strategic-nuclear-arsenals-could-double-in-size/.

Russia's Information Warfare on WMDs in the Ukraine Conflict

By Kiley McCormick[1]

INTRODUCTION

Over the last 10 years, Russia has become among the most prolific disseminators of disinformation globally, deploying novel media tools to build upon a century-long legacy of information warfare. Since Russia's recent invasion of Ukraine, the Russian government's attention has focused on attempts to drum up domestic and international support by attacking Ukraine and its Western allies and valorizing President Vladimir Putin, his regime, and his military campaign. Some of the most concerning and oft-repeated claims have surrounded chemical, biological, and nuclear weapons. Such disinformation is not only deleterious to the Ukrainian war effort, but to international arms control at large.

This paper examines emerging disinformation tactics, technologies, and patterns used by Russia regarding weapons of mass destruction (WMDs) during the Ukraine conflict through Telegram metadata and primary-source data from English, Russian, and Ukrainian social media and traditional media. This research seeks primarily to describe the information environment surrounding these topics rather than test a given hypothesis.

By mapping the networks of messages in both Russian and Ukrainian being forwarded between accounts pre-coded as sources of disinformation, as well as official government sources of information, this paper identified consistent echo chambers forming on ideological lines for each of the issue areas investigated. The divide between pro-Russian and pro-Ukrainian sources of information is increasingly pronounced, implying that individuals who are getting messaging from one perspective are increasingly less likely to encounter messaging from the other side.

1 Kiley McCormick is a contractor for the U.S. federal government. The views expressed in this paper are those of the author and do not reflect the policy of position of any company, agency, or government.

Although Kremlin-associated actors appear to push narratives around WMDs, particularly biological laboratories, consistently across platforms and the studied timeframe, the narratives themselves do not appear to elicit particularly high engagement or interest among audiences. This would thus imply that the motivation for continuing to propagate such content goes beyond simple audience engagement. It is possible that the Kremlin maintains these narratives as a low-grade buzz in the information sphere in case of an event in the future where a body of belief in these ideas developed over time becomes useful, such as a false flag operation.

BACKGROUND

WMDs have been a consistent theme in Kremlin disinformation since the end of World War II. Disinformation narratives around biosecurity have been circulating since the 1950s, ranging from U.S. bioweapons programs to the AIDS epidemic. The influence of these campaigns goes far beyond the conflicts from which they arise, seeping into global conversations around arms control and eroding delicately upheld international norms.[2]

Russia's current disinformation tactics, although adapted to the digital age, are directly descended from Soviet-era propaganda strategies. Similar to Soviet practices, Russian disinformation campaigns seek to exploit social cleavages, undermine public trust, and foster conspiracy theories.[3] In the mid-2000s, the Kremlin undertook an "amplified reinvestment" in Soviet disinformation strategies in reaction to a perceived Western advancement upon the former Soviet space. Simultaneously, there was a growing sentiment in the Kremlin that Western public opinion had irreparably soured against Russia.[4]

The Kremlin systematically presented alternative narratives and dissenting voices through outlets such as Russia Today to counter "Western" rhetoric. These alternative narratives exploited existing crises in public trust and the rise of conspiratorial thinking in the wake of 9/11.[5] Often, these conspiracies would originate in other geographies that Russian media outlets would amplify, such as claims of U.S. bioweapons originating in foreign newspapers that Russian media would later pick up and propagate.[6] Moscow has regularly leveraged disinformation on WMDs to evade attribution and accountability for violations of global nonproliferation treaty obligations, especially in the wake of the Russian government's use of chemical weapons against Sergei Skripal in 2018 and Aleksei Navalny in 2020.

Thus far in the conflict in Ukraine, Russia's WMD disinformation has focused primarily on nuclear, radiological, chemical, and biological warfare. A common narrative currently pushed by the Kremlin asserts that the United States, with or without Ukraine, has in some way been hiding a biological weapons program or illegal experimentation with virulent diseases.[7]

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2 John Dotson, "Beijing's Propaganda Support for Russian Biological Warfare Disinformation, Part 1: Accusations Concerning the War in Ukraine," Jamestown Foundation, *China Brief* 22, no. 11 (June 17, 2022), https://jamestown.org/program/beijings-propaganda-support-for-russian-biological-warfare-disinformation-part-1-accusations-concerning-the-war-in-ukraine/

3 Dennis Kux, "Soviet Active Measures and Disinformation," U.S. Army War College, *Parameters* 15, no. 4 (July 1985), https://doi.org/10.55540/0031-1723.1388.

4 Keir Giles, *Moscow Rules: What Drives Russia to Confront the West* (Washington, DC: Brookings Institution Press, 2019).

5 Ilya Yablokov, "Russian Disinformation Finds Fertile Ground in the West," *Nature Human Behaviour* 6 (June 2022): 766–67, https://www.nature.com/articles/s41562-022-01399-3.

6 Sam Meyer, *Fake News, Real Dangers: The Dangers of WMD Disinformation* (Washington, DC: Nuclear Threat Initiative, December 2017), https://www.nti.org/analysis/articles/fake-news-real-consequences-dangers-wmd-disinformation/.

7 Iuliia Alieva, Lynnette Hui Xian Ng, and Kathleen M. Carley, "Investigating the Spread of Russian Disinformation about Biolabs in Ukraine on Twitter Using Social Network Analysis," in *2022 IEEE International Conference on Big Data (Big Data)*

These assertions—like all well-conceived disinformation campaigns—are seated in some element of truth or previously held belief and combine facts about the U.S. historical bioweapon experiments with long-standing rumors to create a grand narrative of U.S. hybrid warfare in the present. Disinformation on bioweapons and laboratories during this current conflict has flourished along several key themes, including the notion that the biological weapons programs of the United States, Ukraine, and other collaborators may spread to Russia, that the United States uses Slavs as test subjects, and that the United States wants to spread its secret programs to other former Soviet states. Until recently, Russia was involved in the very cooperative threat reduction programs from which many of these conspiracy theories draw their inspiration. Anecdotally, if one searches "biolaboratories" or "biological weapons" on Yandex, or in Russian or Ukrainian on Google, almost every link is to disinformation on U.S. or Ukrainian involvement in secret bioweapons programs, appearing on official news sites, blogs, and social media accounts. Many of these narratives follow the same thread that runs through much of the Kremlin's disinformation narratives: the West is not trustworthy, is not part of the "Slavic brotherhood," and will take advantage of Slavs and other non-Westerners if possible.

Although these recent accusations of U.S. bioweapon or pathological research have been uniformly and widely debunked, Russia has managed to amplify and lend credence to these claims beyond social media. In June 2022, Russia triggered Article V under the Biological Weapons Convention, only the second time such an action has been made in the convention's history, providing a legitimating platform for Russia's accusations. In multiple conversations with defense personnel in France, Turkey, the United Kingdom, and the United States, Russian defense minister Sergei Shoigu accused Ukraine of possessing and intending to use a dirty bomb. A dirty bomb, which combines explosives and radioactive material, could cause significant physical and psychological harm to a targeted population, and verification of possession is complicated by its relatively low barrier of accessibility compared to a nuclear weapon. Although discredited by NATO's secretary general, Russia's accusations of a Ukrainian dirty bomb remained under inspection by the International Atomic Energy Agency until November 2022.[8] In February 2023, Russia's state investigative committee reiterated the claim without evidence.[9]

Although launching a dirty bomb violates international humanitarian law, Russia's adherence to international norms has so diminished over the course of the conflict that their deployment of such a weapon is not unthinkable, and Ukrainian president Volodymyr Zelensky believes Shoigu's accusation proves that Russia is preparing its own nuclear attack.[10] This degradation has bled into every facet of international arms control; for example, Russia has already refused to agree to the final nuclear Non-Proliferation Treaty document over worries regarding "military activities near Ukrainian nuclear power plants."[11] In January 2023, the United States accused Russia of preventing inspections of its nuclear facilities and hence violating the New START Treaty, the last major pillar of post–Cold War nuclear arms control between the two countries.[12]

(Osaka, Japan: IEEE, December 2022), https://ieeexplore.ieee.org/document/10020223.

8 "IAEA Says No Sign of 'Dirty Bomb' Work at Ukrainian Sites; Kyiv Hails Report," Reuters, November 3, 2022, https://www.reuters.com/world/europe/iaea-says-no-sign-dirty-bomb-work-sites-inspected-ukraine-2022-11-03.

9 "Without Giving Evidence, Russia Says It Probes Ukraine Use of Chemical Weapons," Reuters, February 6, 2023, https://www.reuters.com/world/europe/without-supplying-evidence-russia-says-its-investigating-alleged-ukrainian-use-2023-02-06/

10 Michael N. Schmitt, "Ukraine Symposium – Dirty Bombs and International Humanitarian Law," Lieber Institute West Point, October 26, 2022, https://lieber.westpoint.edu/dirty-bombs-international-humanitarian-law/.

11 John V. Parachini, "Debunking Russian Lies about Biolabs at Upcoming U.N. Meetings," RAND Corporation, September 12, 2022, https://www.rand.org/pubs/commentary/2022/09/debunking-russian-lies-about-biolabs-at-upcoming-un.html.

12 Humeyra Pamuk, "US Says Russia Violating New START Nuclear Arms Control Treaty," Reuters, January 1, 2023, https://www.

Although Russian nuclear propaganda in many ways defined the Cold War, the threat of nuclear war abated after the fall of the Berlin Wall and during the 1990s and early 2000s when Russia appeared to be growing closer to the West. In the last decade, however, Russia has increasingly used its nuclear arsenal as a threat to the former Soviet space.[13] In the Russian International Affairs Council's December 2021 report, *Space Without Borders: Russia and Its Neighbors*, officials asserted their right to use force against post-Soviet territories that fail to adhere to Russia's will.[14] In the context of the ongoing Russian invasion of Ukraine, Russian disinformation has consistently blamed the West for nuclear escalation, alleging that the West wants to "instigate a world war," while portraying Russia as a victim that has no other option but to respond as necessary.[15] Such brinkmanship, combined with apparent factual and ethical validation through disinformation, has the potential to justify, instigate, or exacerbate a conflict using WMDs that could imperil the international community. Hence, it is vital to understand the role that WMDs plays in Russia's disinformation campaign.

METHODOLOGY

This work employs a review of relevant literature and data from Telegram, other social media sites, and traditional media. The primary quantitative data source was a large-scale algorithmic database of Telegram messages, which involves machine learning to track data pulled from pro-Russian and anti-Ukrainian channels. Some limited data from social media platforms such as Instagram was collected manually and analyzed qualitatively to complement the quantitative Telegram analysis.

DATA COLLECTION METHODOLOGY

This analysis was carried out in English, Russian, and Ukrainian. Because the database was not coded to accommodate languages that use declensions, such as Russian and Ukrainian, this work employs a method of multi-syllabic filtering using "stem" terms, which are sufficiently unique series of letters used to capture the vast majority of uses of the term without excluding other forms of the word.[16] Below is one such example:

- **English key filtering term**: "Nuclear"
- **Russian nominative singular translation**: "ядерный"
- **Created stem-based search term for filtering**: "ядерн"

The stem above is a rare combination of letters unlikely to appear in any term other than the Russian word for nuclear, and thus captures most if not all possible grammatical variations of the word, without the significant risk of false positives. Unfortunately, the database could not search phrases, so terms such as "dirty bomb" were not usable, and some letter series were too common, such as the Russian and Ukrainian abbreviations for WMDs. Terms considered unworkable were omitted, though they could be studied in further research using a database formulated to accommodate Cyrillic grammar and multi-word phrases.

reuters.com/world/russia-not-complying-with-inspection-obligation-under-nuclear-arms-treaty-us-2023-01-31/.

13 Kristin Ven Bruusgaard, "Russian Nuclear Strategy and Conventional Inferiority," *Journal of Strategic Studies* 44, no. 1 (October 2020): 3–35, https://doi.org/10.1080/01402390.2020.1818070.

14 Vitaliy Syzov, "Russia's Comments about a 'Dirty Bomb' Betray the State's Weakness," Wilson Center, October 27, 2022, https://www.wilsoncenter.org/blog-post/russias-comments-about-dirty-bomb-betray-states-weakness.

15 "The Dangerous Case of Nuclear Corners," EUvsDiSiNFO, September 29, 2022, https://euvsdisinfo.eu/the-dangerous-case-of-nuclear-corners/.

16 Kieth Hautala, "When Grammar Meets Programmer," University of Kentucky, College of Arts and Sciences, https://linguistics.as.uky.edu/when-grammar-meets-programmer.

FINDINGS

For each key term, the most highly shared messages that contained false or misleading information about WMDs or bioweapons were analyzed. Nodal network maps that illustrate the communities that have shared information related to that particular term most frequently were also analyzed. The database contains 15,118,460 messages and 12,817 unique handles from February 1, 2022, to February 1, 2023, which is the period used for all subsequent analysis unless specified.

Nuclear (RUS: ядерный; UKR: ядерний)

Over the study time frame, the Ukrainian and Russian root term "ядерн" appeared in 70,819 messages across 1,377 unique handles.

A nodal network mapping the usage of this term for the month of February 2022 shows that information related to nuclear capabilities could be sequestered into two major groups. On the one side of the network, connections between President Zelensky, the official Kyiv City account, and other pro-Ukrainian sources were visibly connected and substantially smaller than the groups on the other side of the map, which were centered around @rybar and @rt_russian. @rybar in particular is a prominent source of information for all of these terms. Additional information about this account is in the Findings section below.

The nodal map shows that, in terms of sheer volume, the amount of information being put out by the two top pro-Russian accounts significantly dwarfed the flow of information from official Ukrainian channels. The information from official Ukrainian channels was not reaching the users who were getting their information primarily from top Russian bloggers and Russian state media. The divide between the two is stark, meaning that Russian-speaking accounts had little access to the Ukrainian perspective on nuclear issues related to the ongoing invasion unless they specifically sought it out.

Over the observed time period, the nodal map demonstrates that the two communities grew further apart over the course of the conflict, exacerbating the already stark ideological divide.

In English, the database had 1,504 messages over the study time period, about 2 percent of the number of messages in Cyrillic, and 213 unique handles. Among these, the top messages are in Russian and Ukrainian, and most of these 1,504 appear to only include "nuclear" in hashtags.

Biolaboratories (Russian: биолаборатории; Ukrainian: біолабораторії)

Over the same time period, the Ukrainian and Russian root term "биолаборатор" appeared in 4,046 messages from 445 unique handles.

The nodal network for this term has one primary cluster populated by major Russian-affiliated channels, including @rybar and @bio_genie. As opposed to "nuclear," which appears in many accurate or neutral news reports, "biolaboratories" is primarily used by pro-Russian actors.

The time-series graph shows the vast majority of mentions of "biolaboratories" in the dataset take place in March and April of 2022. This highly concentrated series of frequency spikes are consistent with a campaign of disinformation in which a narrative utilizing a fear of putative biological laboratories serves as a pretext by influential actors seeking to justify the initial invasion and early stages of the war. It is also possible that influencers and agents of disinformation began to use narratives on biological laboratories less frequently because they were not playing well with target audiences or eliciting the desired engagement.

Biological Weapon (Russian: биологическое оружие; Ukrainian: Біологічні агенти)

The Ukrainian and Russian root term "биологическое оружие" appeared in 5,636 messages from 638 unique handles. The time series of "biological weapon" is very similar to "biolaboratories" and is also centered around one primary cluster of pro-Russian actors, particularly @bio_genie and @neoficialniybezsonov. The time series graph depicts a large spike in the observed frequency of the term "biological weapon" just as the invasion began, with very minimal resurgence over the subsequent year.

Chemical (Russian: Химическое; Ukrainian: Хімічна)

The Ukrainian and Russian root term "Химическ" appeared in 6,884 messages from 730 unique handles. Contrasting with "biolaboratories" and "biological weapon," the search term "chemical" produces a much more diffuse nodal network, with several observable circular constellations around major channels such as @rybar, @nationconsunion, and @karaulny. This is likely because the term "chemical" has far more diffuse meanings than "nuclear" or "bioweapon," many of them innocuous. As a result, this search collected many false positives.

ANALYSIS

Salient Languages: Russian and Ukrainian

Disinformation was promulgated in Ukrainian as well as Russian. Anti-Ukrainian and anti-Western rhetoric were targeted toward both language communities. English was barely used.

Salient Theme: Biological Laboratories

A theme of note among disinformation narratives on WMDs concerns U.S.-funded biological laboratories on Ukrainian territory. The idea that the United States is operating secret biological laboratories with the intent to develop dangerous pathogens to be used as weapons against ethnic Russians was ubiquitous throughout the Telegram analysis, with qualitative examination of TikTok and Instagram corroborating the prevalence of these conspiracy theories across platforms.

Russia's claims around biological laboratories since the beginning of the conflict have involved the following key narratives:[17]

1. Secret U.S. biological laboratories have been operating for decades.[18]
2. The United States is relocating its biological laboratories to foreign countries to conduct high-risk experiments without exposing the U.S. population or running afoul of regulators.[19]
3. Russians are in danger of being infected with dangerous diseases as a result of programs in neighboring states, such as Georgia and Ukraine.[20]

17 N. Burbyga, "US Biological Weapons in Ukraine: Why the West and the UN Do Not See the Facts," Noviyi Izvestia, December 9, 2022; and L. Savin, "Hybrid Biological Warfare," Katehon, November 24, 2022, https://katehon.com/ru/article/gibridnaya-biologicheskaya-voyna.

18 "Department of Defense: The United States Is Moving Biolaboratories to Other Countries Due to the Risk of Accidents," RIA News, November 26, 2022, https://ria.ru/20221126/biolaboratorii-1834450954.html.

19 "Foreign Ministry: It Is Important to Make Sure That There Is No Threat to Russia from Bioresearch," Ren TV, December 10, 2022.

20 "The United States Will Transfer Biological Laboratories from Ukraine to Other Countries, the Ministry of Defense Announced," RIA News, March 9, 2022, https://ria.ru/20220903/biooruzhie-1814233714.html; and "The Russian Ambassador to the United States Said That the Pentagon Is Transferring Biological Laboratories from Ukraine to Third Countries," TASS, November 4, 2022, https://tass.ru/politika/16248633.

4. The Pentagon is transferring its uncompleted bioweapons programs to other countries of the post-Soviet space and Eastern Europe, such as Bulgaria, the Czech Republic, and the Baltic countries, threatening Russian security in an "uncontrollable" manner.[21]
5. The United States is using the Ukrainian army for bioweapon testing to use on Russia.[22]
6. The Pfizer and Moderna vaccines are bioweapons.[23]
7. The Ukrainian authorities have deliberately infected people in the Luhansk region.[24]
8. There is a secret NATO biological laboratory in Mariupol.[25]
9. The United States is training birds in Ukraine to carry bioweapons to Russia, experimenting with bats in Ukraine to carry "viral pathogens," and weaponizing mosquitoes.[26]
10. The United States is turning Ukrainian soldiers into "ethnic bioweapons" to target ethnic Slavs such as Russians.[27]

Russia's government has used a variety of different channels to spread this disinformation. The first is through official statements by the Russian government (and its respective consulates), accompanied by affirming coverage in state-owned media. The second is the proliferation of these narratives on social media platforms such as Telegram and Instagram. Third, the Russian government has attempted to use international organizations to further its disinformation. In March 2022, Russia called for a special meeting of the UN Security Council to discuss its false claims regarding illegal U.S. involvement in biological laboratories in Ukraine. After the UN high representative for disarmament affairs briefed Security Council members that these claims were patently false, Russia turned to another international forum, triggering Article V of the Biological Weapons Convention.[28] Article V allows states-parties to call for formal consultation in cases where states believe that other parties have violated the convention, an instrument that has only been triggered once in its nearly 50-year history. The meeting, which took place in September 2022, led to no consensus over the accusation, but no other state made formal accusations against the United States and Ukraine, and the vast majority supported U.S. and Ukrainian claims against Russian disinformation. [29]

21 "US Biolaboratories in Ukraine: Next in Line for Central Asia?," Sputnik News, October 21, 2022.
22 Yana Osadcha and Victoria Andreeva, "US Biolaboratories and Bills Infected with Tuberculosis: The Ministry of Health Refuted 4 myths of Russian propaganda," *Pravda*, June 28, 2022, https://life.pravda.com.ua/health/2022/06/28/249322/.
23 Ibid.
24 Ibid.
25 I. Silenko, "Everything You Need to Know about the Fighting Mosquitos, and What the Buzz Is About," Athens News, November 20, 2022; "US Biolaboratories in Ukraine Aim to Reduce Russia's g=Gene Pool – Khrolenko," Sputnik News, October 26, 2022; Daniel Villareal, "Russian Conspiracy Theory Says US Training Birds to Spread Bio Weapons," *Newsweek*, March 11, 2022, https://www.newsweek.com/russian-conspiracy-theory-says-us-training-birds-spread-bio-weapons-1687399; and "UN Dismisses Russian Claim of Ukraine-US Biological Weapons Program," France 24, March 11, 2022, https://www.france24.com/en/live-news/20220311-un-dismisses-russian-claim-of-ukraine-us-biological-weapons-program.
26 Parachini, "Debunking Russian Lies about Biolabs at Upcoming U.N. Meetings."
27 "United Nations Not Aware of Any Biological Weapons Programmes, Disarmament Chief Affirms as Security Council Meets to Address Related Concerns in Ukraine," United Nations, SC/14827, March 11, 2022, https://press.un.org/en/2022/sc14827.doc.htm; and D. Feakes, "Biological Weapons Convention Formal Consultative Meeting," United Nations Office for Disarmament Affairs, 2022, https://meetings.unoda.org/bwc-fcm/biological-weapons-convention-formal-consultative-meeting-2022
28 "BWC Formal Consultative Meeting 26 August and 5-9 September 2022, Final Report – Advance Version," United Nations Office of Disarmament Affairs, 2022, https://documents.unoda.org/wp-content/uploads/2022/09/FCM-final-report-ADVANCE-VERSION.pdf; and Jez Littlewood and Filippa Lentzos, "Russia's Alleged Bioweapons Claims Have Few Supporters," Bulletin of the Atomic Scientists, October 11, 2022, https://thebulletin.org/2022/10/russias-alleged-bioweapons-claims-have-few-supporters/.
29 Pablo Barberá, "Social Media, Echo Chambers, and Political Polarization," in *Social Media and Democracy: The State of the Field and Prospects for Reform,* Nathaniel Persily and Joshua A. Tucker, eds. (Cambridge, UK: Cambridge University Press, August 2020), 34; and Fabian Baumann et al., "Modeling Echo Chambers and Polarization Dynamics in Social Networks,"

Simultaneously, most mentions of bio-related topics were concentrated toward the beginning of the conflict in the time series of Telegram data, indicating that it was potentially a less successful narrative than initially hoped and was eventually abandoned. The time series for the term "nuclear," by comparison, spiked around news events but continued to appear regularly over the time frame.

MESSAGING ECHO CHAMBERS

One of the most glaring takeaways from this research is how information consumers and producers sequester themselves into isolated groups that have little to no interaction with one another. The findings on this point support the literature on information echo chambers and the general wisdom about how polarized groups reinforce polarization through social media channels.
This research shows how this phenomenon is empirically true in the case of information and disinformation surrounding the Russian invasion of Ukraine.

In each of the nodal network maps, there is a stark contrast between groups of Ukrainian and Russian channels. Networks build around a few prominent accounts that are forwarded by a much larger group of less prominent accounts, each with its own small set of followers who also pass on these forwarded messages. These forwarding pathways are repeatedly reinforced over time, which builds out large networks for the flow of information from the same sources. Each term showed a bipolar network of messages: one large network surrounding Russian channels and one smaller network surrounding Ukrainian channels. These two networks have little interaction.

This divide is not only present when separating for language but also holds when separating for ideological affiliation. Of course, language and ideology are closely interrelated in this conflict, but even when accounting for pro-Ukrainian Russian-speaking channels, there is little interaction between pro-Russian and pro-Ukrainian sources. As is true in most cases of repeated disinformation, ideology serves as a self-organizing variable that keeps people from consuming or even encountering information that might cause them to question the dogmas of their deeply rooted ideologies. Even moderate pro-Russian or pro-Ukrainian Telegram users will thus have a hard time locating nuanced information on the conflict because of how deeply ingrained these networks are. Network isolation of this degree is ripe for the mass proliferation of disinformation.

KEY ACTORS

Rybar (Handle: @rybar ; Russian: Рыбарь): One of the most popular and influential "independent" channels that engages with these narratives is Rybar. Rybar is not officially affiliated with any government or media company, and until July 2022, the identity of its owner was unknown. Journalists from The Bell, one of few Russian independent online newspapers still operating, revealed in July 2022 that the account is headed by Mikhail Sergeevich Zvinchuk, a former Russian military intelligence (GRU) special forces operator. Zvinchuk worked in the press service of the Russian Ministry of Defense during the 2015–2017 Syria conflict and organized visits of Russian journalists to the country. Zvinchuk retired from the army in 2019 and on December 20, 2022, by order of Vladimir Putin, was included in the working group for mobilization. In an interview with the RTVI TV channel in 2022, Zvinchuk stated that the channel employs about 40 permanent employees with a monthly budget of 4 million rubles. According to Zvinchuk, the channel is funded by donations.[30]

Physical Review Letters 124, 048301 (January 2020), https://doi.org/10.1103/PhysRevLett.124.048301.

30 "Mikhail Sergeevich Zvinchuk," Wikipedia, updated November 16, 2023, https://ru.wikipedia.org/wiki/%D0%97%D0%B2%D0%B8%D0%BD%D1%87%D1%83%D0%BA,_%D0%9C%D0%B8%D1%85%D0%B0%D0%B8%D0%BB_%D0%A1%D0%B5%D1%80%D0%B3%D0%B5%D0%B5%D0%B2%D0%B8%D1%87.

According to the journalists who unmasked Zvinchuk, Rybar, which has over a million followers, is

> the most important source of information for analysts and the media. The channel publishes five or six detailed reports a day covering each theater of combat, providing highly detailed and swiftly updated maps. The channel's data is regularly used by CNN and Bloomberg. And the influential US-based Institute for the Study of War, whose work is used by all global media, can have 20 links to Rybar in a single report when a major battle is underway.[31]

Despite its pro-Russian bias, Rybar attempts to maintain a facade of impartiality; it refrains from using derogatory terms for Ukrainians and publishes criticisms of the Russian government.

Boris Rozhin (Handle: @Boris_Rezhin ; Russian: Борис Рожин): Boris Rozhin is the owner of the Telegram channel "Colonelcassad" and the associated LiveJournal. His Telegram channel boasts over 840,000 subscribers, and his LiveJournal has the second-most social capital Cyrillic Services users after Russian blogger Lena Miro. LiveJournal is a Russian-owned social media site widely used by Russian public figures and political pundits. Rozhin claims to be a native of Sevastopol and has been blogging since 2009.

Since the beginning of the invasion, Rozhin has used his Telegram to organize regular collection drives for military equipment, such as unmanned aerial vehicles, communications and surveillance equipment, bulletproof vests, ammunition, and cars. According to available information, several hundred million rubles were collected for the needs of the army through the Telegram channel. The account actively collects information on the location and movement of Ukrainian troops for transmission to the Russian military. Rozhin fell under state sanctions in Ukraine for 10 years by presidential decree in January 2023.[32] Rozhin is regularly quoted by Russian news outlets as a "military expert."[33]

LIMITATIONS

The above research has attempted to describe disinformation on WMDs since the beginning of Russia's invasion of Ukraine. Addressing this crisis is, however, far more difficult than mapping it. Tracing the efficacy and reach of both disinformation campaigns and counter-disinformation efforts is difficult for several reasons:

1. There are about 5 billion social media users in the world who are constantly sharing billions of messages every day from every country in the world. Capturing this global population accurately in a laboratory study is impossible. Thus, any laboratory study on the effect of disinformation or counter-disinformation is, by necessity, localized, and its results, even if efficacious, may not be transferable to the truly global audience that social media companies govern. It is still possible, however, to study different perspectives on information in this large field and home in on those that attract large followings.
2. Social media companies are not sharing the vast wealth of data they possess with

31 "Unmasking Russia's influential pro-war 'Rybar' Telegram channel," The Bell, November 22, 2022, https://thebell.io/unmasking-russia-s-influential-pro-war-rybar-telegram-channel.

32 "Along the Sanction Persons: Boris Alexandrovich Rozhin," War & Sanctions, https://sanctions.nazk.gov.ua/en/sanction-person/21990/; "Colonel Kassad," WikiReality, https://wikireality.ru/wiki/%D0%9A%D0%BE%D0%BB%D0%BE%D0%BD%D0%B5%D0%BB%D1%8C_%D0%9A%D0%B0%D1%81%D1%81%D0%B0%D0%B4; and "Colonel Cassad," Live Journal, https://colonelcassad.livejournal.com/.

33 V. Dushin, "Military Expert Rozhin Assessed the US Reaction to the Fall of the MQ-9 Reaper Drone into the Black Sea," Grazeta, March 15, 2023; "Boris Rozhin – Latest News," Lenta.ru, https://lenta.ru/tags/persons/rozhin-boris/; and "Experts - Boris Rozhin," Svobodnaya Pressa, https://svpressa.ru/experts/boris-rozhin/.

governments or researchers, nor are they able to analyze it or adequately moderate it themselves. What researchers understand from the internet and social media by sheer observation is only a small fraction of the real picture.

3. The effect of messaging, truthful or not, is difficult to quantify or isolate. Although an adjustment in opinion might be observable, it is difficult to understand how much content is necessary to sway behavior or how long the effects might last even in laboratory settings, let alone in real life among different demographics.
4. Disinformation remains an understudied, poorly understood topic. The field of disinformation is relatively new and hence even more so under-examined. The present body of literature is unable to capture the problem in its entirety.
5. Disinformation is a highly politicized topic.[34] Terms such as "disinformation," "misinformation," "propaganda," and "fake news" are often and increasingly deployed by high-influence individuals, such as politicians and titans of industry, to dismiss anything with which that given person disagrees. Content moderation is often conflated with censorship, diminishing the willingness of social media companies and governments to act. For example, social media companies often hesitate to act on misinformation, fearing it will align them with a particular cause, and hesitate to moderate their content in ways that might diminish their engagement and revenue.[35]

CONCLUSION

Disinformation is a growing crisis in democracies, and elsewhere, that has only recently begun to receive high-level attention: it was mentioned in the U.S. National Security Strategy for the first time in 2015 but has been referenced in every NSS since. The 2022 National Security Strategy references the danger disinformation poses:

> Competitors now commonly seek adverse changes in the status quo using gray zone methods – coercive approaches that may fall below perceived thresholds for US military action and across areas of responsibility of different parts of the US Government. Russia employs disinformation, cyber, and space operations against the United States and our Allies and partners, and irregular proxy forces in multiple countries. Other state actors, particularly North Korea and Iran, use similar if currently more limited means.[36]

This study demonstrates that disinformation not only endangers democracy and other political values of political importance but also creates a potential risk of escalation in chemical, biological, and nuclear engagement which could imperil the security of the global community.

The United States relies on four sources of power—diplomacy, information, military, and economic—to exert influence abroad.[37] Informational power can no longer rely on military intelligence and

34 Chau Tong et al., "'Fake News Is Anything They Say!'—Conceptualization and Weaponization of Fake News among the American Public," *Mass Communication and Society* 23, no. 5 (July 2020): 755–78, https://doi.org/10.1080/15205436.2020.1789661.

35 Sarah Myers West, "Censored, Suspended, Shadowbanned: User Interpretations of Content Moderation on Social Media Platforms," *New Media & Society* 20, no. 11 (May 2018): 4366–83, https://doi.org/10.1177/1461444818773059.

36 The White House, *National Security Strategy* (Washington, DC: The White House, October 2022), https://www.whitehouse.gov/wp-content/uploads/2022/10/Biden-Harris-Administrations-National-Security-Strategy-10.2022.pdf.

37 Donald M. Bishop, "DIME, not DiME: Time to Align the Instruments of US Informational Power," The Strategy Bridge, June 20, 2018, https://thestrategybridge.org/the-bridge/2018/6/20/dime-not-dime-time-to-align-the-instruments-of-us-informational-power.

information operations alone, even within the realm of WMDs, traditionally a military domain. Information power, especially with reference to counter-disinformation and understanding disinformation narratives, has become critical to creating a safer world without serious biological, nuclear, or chemical attacks.

Although the purview of this study only allows for a brief examination of the world of Kremlin disinformation, this work is intended to provide a descriptive background that can be used to understand the extant information environment and to build upon in further research, especially research that focuses on WMDs. Recent developments in artificial intelligence have opened up opportunities for the construction of compelling and dangerous disinformation, while rapid developments in biotechnology have once again put biological warfare at the forefront of international security concerns.[38] These changes demonstrate that efforts to curtail disinformation will be central to any campaign to reduce risks from WMDs and that researchers of disinformation must take account of the growing import of propaganda related to nuclear, biological, and chemical weapons.

38 Sébastian Bubeck, "Sparks of Artificial General Intelligence: Early Experiments with GPT-4," arXiv:2303.12712, April 2023, https://doi.org/10.48550/arXiv.2303.12712; and Katarina Kertysova, "Artificial intelligence and Disinformation: How AI Changes the Way Disinformation Is Produced, Disseminated, and Can Be Countered," Security and Human Rights Monitor, November 2019, https://www.shrmonitor.org/assets/uploads/2019/11/SHRM-Kertysova.pdf.

A Broken Ladder

Antiquated Escalatory Calculus in the Age of Nonstrategic Nuclear Weapons

By Gleb E. Smirnov[1]

INTRODUCTION

Most policy experts and academic practitioners doubted that the invasion of Ukraine would ever occur. The United States, NATO, and U.S. partners cannot miscalculate Russian political will again.[2] The United States' 2022 National Defense Strategy (NDS) declares that U.S. priorities include "deterring strategic attacks against . . . Allies and partners" and "deterring aggression—while being prepared to prevail in conflict when necessary—prioritizing the . . . Russia challenge in Europe."[3] The NDS also states that the Department of Defense "must address . . . Russia as an acute threat" as well as "complex escalation dynamics," such as "rapidly evolving domains and technologies."[4]

The possibilities of traditional nuclear use in Ukraine may be present, although they are not predictable. The Russian employment of nonstrategic nuclear weapons (NSNWs) or tactical nuclear weapons (TNWs) is an asymmetric capability that will deter international nuclear response—

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2 Jonas J. Driedger and Mikhail Polianskii, "Utility-Based Predictions of Military Escalation: Why Experts Forecasted Russia Would Not Invade Ukraine," *Contemporary Security Policy* 44, no. 4 (2023): 544–60, https://doi.org/10.1080/13523260.2023.2259153.

3 U.S. Department of Defense, *National Defense Strategy* (Washington, DC: Department of Defense, October 2022), https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.PDF.

4 Ibid.

assuming nuclear effects remain matched to the thresholds and effects of multiple conventional weapons and civilian casualties are extremely low. NSNW employment in Ukraine is a key example under the NDS of complex escalation dynamics. However, despite the release of the NDS 10 months after the initial Russian invasion of Ukraine in 2022, the NDS does not specifically mention deterring or challenging Russia's calculus for NSNW use in Ukraine, and instead only addresses use in or around NATO territories. Alternatively, the Nuclear Posture Review (NPR) states that flexible and tailored U.S. nuclear triad capabilities "are key to ensuring Russia's leadership does not miscalculate regarding the consequences of nuclear use on any scale, thereby reducing their confidence in both initiating conventional war against NATO and considering the employment of non-strategic nuclear weapons in such as conflict."[5]

NSNWs and TNWs are not weighted adequately within the framework of international escalatory calculus. Theories pertaining to strategic stability suggest that a nuclear second strike will likely target a first-use actor after initial nuclear weapons use.[6] These theories have traditionally focused on strategic intercontinental ballistic missile exchanges or nuclear use from the traditional triad (specifically submarine-capable platforms).[7] The theoretical employment of an NSNW in the war in Ukraine will (a) create novel fractures in historical nuclear taboo, (b) shift nuclear-use thresholds for future generations, (c) reestablish Russian credibility and confirm political will, (d) psychologically shock and deter NATO allies from directly intervening in Ukraine, and, perhaps most importantly, (e) challenge clear and logical nuclear escalation or second-strike options within Ukrainian, Belarusian, and Russian territories.

Given these circumstances, this policy paper aims to (1) describe the problematic context of definitions and escalation considerations surrounding the hypothetical use of NSNWs and TNWs in the war in Ukraine; (2) argue that the 2022 NDS and NPR do not effectively prioritize or define Russian aggression in Ukraine, deterrence to prevent the use of NSNWs in Ukraine, or which countries count as U.S. "partners"; and (3) issue a host of policy options to control and manage regional escalation if Russia utilizes NSNWs or TNWs in Ukraine.

BACKGROUND

On March 25, 2023, Russian president Vladimir Putin announced that Russia would be stationing TNWs in Belarus.[8] Belarus confirmed this action, indicating that it would host Russian TNWs in response to years of Western pressure, such as sanctions and NATO military activity near its border.[9] The decision to move nuclear weapons into Belarus served as a bold and deliberate signal of escalation pointed toward the United States and NATO.[10] Furthermore, Putin notified the world that Russia had developed the capability to deliver TNWs via modified Belarusian bombers and had trained pilots to operate them.[11] To make TNW control and coherence more disjointed, Belarusian president Alexander Lukashenko has "suggested he could use them [TNWs] with Russia's agreement

5 Ibid.
6 Rose Gottemoeller, "The Standstill Conundrum: The Advent of Second-Strike Vulnerability and Options to Address It," *Texas National Security Review* 4, no. 4 (2021), 116, 117, https://doi.org/10.26153/tsw/17496.
7 Ibid.
8 Andrew Osborn, "Belarus Says It Will Host Russian Nuclear Weapons to Counter NATO," Reuters, March 28, 2023, https://www.reuters.com/world/europe/belarus-says-it-decided-host-russian-nuclear-weapons-after-nato-pressure-2023-03-28/.
9 Ibid.
10 Ibid.
11 Vladimir Kozin, "Ukrainian Chronicle: Russia Will Deploy Its TNW in Belarus," The International Affairs, March 27, 2023, https://en.interaffairs.ru/article/ukrainian-chronicle-russia-will-deploy-its-tnw-in-belarus/.

if Belarus was threatened with destruction."[12] Concurrent with these events, Russia has suspended its membership in the New Strategic Arms Control Treaty (New START) and suggested that it could resume nuclear testing.[13] In sum, Russia has shown the political will to move NSNWs to Belarus, spent resources to modify Belarusian bombers and train Belarusian pilots for the delivery of NSNWs into Ukraine, and signaled the desire to demonstrate NSNW capability should they need to. U.S. president Joe Biden noted serious concern in response to these bilateral actions and events, stating that "it's worrisome."[14]

NSNWs and TNWs are central to the escalation ladder; they are involved in multiple evolutions of a nuclear exchange or escalation control. To simplify Herman Kahn's full escalation ladder, this policy paper leans on a model of linear escalation as prescribed within *Reconstructing the Ladder: Towards a More Considered Model of Escalation*.[15] This linear escalation model is broken down into five rungs of increasing escalation: diplomatic condemnation, show of force, mobilization, conventional war, and local nuclear war.[16] As prescribed, the war in Ukraine is currently centered on conventional war, with the potential of evolving into local nuclear war. Recent academic considerations have opened various challenges pertaining to the size, use, and calculus of NSNWs and TNWs. Academic literature has raised significant issues with the definitions and scope of NSNWs and TNWs without specifically examining the U.S. and NATO escalation context. When considering the current international stage, should observers rely on official statements with questionable credibility and assume that the existing strategic calculus is fit for this historically unique geopolitical context? Furthermore, is it fair to assume that Russia will forfeit its limited control of strategic territory in Ukraine once conventional forces have been overmatched, killed, or captured, or is it more likely that they will use other escalation means to retain territorial control?

DEMYSTIFYING DEFINITIONS: SPECIAL TACTICAL NUCLEAR WEAPONS

Nuclear weapons and their explosive impact are measured in kilotons (kt). One kiloton is referenced to equal the explosive force of 1,000 tons of TNT.[17]

Strategic nuclear weapons (SNWs) and intermediate nuclear weapons (INWs) have largely been defined or described, but this is not the case for NSNWs. While it is appropriate for SNWs and INWs to be categorized exclusively by their kilometer range, NSNWs and TNWs should not be. NSNWs and TNWs are typically defined as "short-range weapons, including land-based missiles with a range of less than 500 km (about 300 miles) and air- and sea-launched weapons with a range of less than

12 "Lukashenko: Russia Could Put Intercontinental Missiles in Belarus If necessary," Reuters, March 31, 2023, https://www.reuters.com/world/europe/belarus-lukashenko-says-russian-nuclear-arms-needed-deter-threats-west-2023-03-31/.

13 François Diaz-Maurin, "Russia Suspends New START and Is Ready to Resume Nuclear Testing," Bulletin of the Atomic Scientists, February 21, 2023, https://thebulletin.org/2023/02/russia-suspends-new-start-and-is-ready-to-resume-nuclear-testing/.

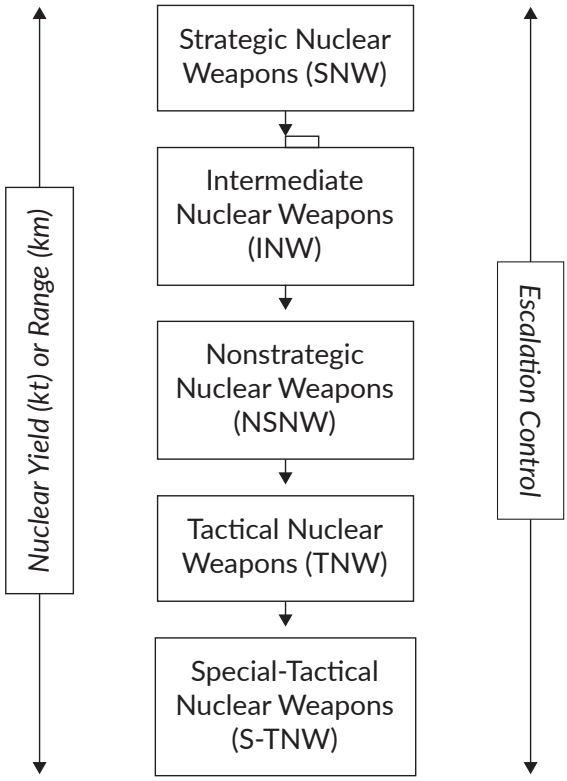
14 Jeff Mason, "Biden Says He Is Concerned about Possibility Russia Sends Nuclear Arms to Belarus," Reuters, March 28, 2023, https://www.reuters.com/world/biden-says-he-is-concerned-about-possibility-russia-sends-nuclear-arms-belarus-2023-03-28/.

15 Jonah Lo, Ng Kang Jie, and Hannah Lo, "Reconstructing the Ladder towards a More Considered Model of Escalation," The Strategy Bridge, September 1, 2022, https://thestrategybridge.org/the-bridge/2022/9/1/reconstructing-the-ladder-towards-a-more-considered-model-of-escalation.

16 Ibid.

17 "Thermonuclear Bomb," Encyclopædia Britannica, October 21, 2023, https://www.britannica.com/technology/thermonuclear-bomb.

Nulcear Weapon Dichotomy



Source: Author's own creation.

600 km (about 400 miles)."[18] This common definition is effective but rudimentary. Coupling NSNWs and TNWs into one definition primarily centered around range is misleading. There must be a separation that decouples NSNWs from TNWs. Relying solely on the effective range of NSNWs and TNWs and not considering yield is also a critical miscalculation. A NSNW should be defined as a nuclear weapon with around a 500 km range and less than a 10 kt payload that is predicated on achieving operational effects. A TNW should be considered a derivative of an NSNW, with around a 500 km range or less, a payload of less than 6 kt, and an objective focus on altering or impeding tactical operations and decisive battlefield victories. These proposed definitions are not all-encompassing; there are exceptions to every rule. However, they should be used as a refined guiding reference and updated when required.

To better illustrate the utility of escalation considerations, TNWs should be nested underneath NSNWs. Furthermore, TNWs must have a derivative sub-definition to articulate special-utility nuclear weapons that are exquisitely small in effect. The sub-definition of special tactical nuclear weapons (S-TNW) must be created to fill this gap. S-TNWs enhance strategic calculus for understanding escalation and retaliatory second strike—S-TNWs can be considered to have an effect of less than 26 GBU-43/B bombs (the largest-yield conventional bomb, equivalent to about 11 tons of TNT). In other words, S-TNWs are a subset of NSNWs and TNWs that produce around the same explosive blast or less than the explosive yield of 26 GBU4-3/Bs. Therefore, S-TNWs are a subset of NSNWs and TNWs with an unknown range and an explosive yield of less than 286 tons of TNT and are used for imposing precise nuclear effects on notable targets for immediate or delayed tactical advantage or responding to NSNW first use.

BENEFITS OF S-TNWS

The advantage of S-TNWs resides in their ability to have a relative yield of 5 to 26 GBU-43/Bs without the need or requirement for specialized aircraft or delivery vehicles. In addition, S-TNWs will not require special aircraft or delivery vehicles to be mated to them for successful use. S-TNWs simultaneously deliver a solution to U.S. capability gaps within the escalatory ladder while providing a nuclear capability in potential communications and air, sea, or electronically denied environments. Within limited nuclear war, S-TNWs also aid in escalation control.

18 Nikolai Sokov, "Tactical Nuclear Weapons (TNW)," Nuclear Threat Initiative, April 30, 2002, https://www.nti.org/analysis/articles/tactical-nuclear-weapons/.

RUSSIAN NSNW ANALYSIS

In *Nuclear Incoherence: Deterrence Theory and Non-Strategic Nuclear Weapons in Russia*, Dimitry Adamsky outlines international security concerns for Russia's leading collection of, and reliance on, NSNWs.[19] Adamsky reveals that a portion of Russian "nuclear deterrence aims to deter a large-scale conventional war . . . [and] to strike with a non-strategic nuclear arsenal."[20] According to Adamsky, this novel concept is described as Russia's "regional nuclear deterrence," or RND.[21] Unironically, Russia's NSNW "location[s], operational status, doctrines and pertaining deterrence framework remain ambiguous."[22] Furthermore, the issue in identifying Russian NSNW use, size, status, and calculus is centered in fragmentation, ambiguity, and secrecy.[23] Moreover, Russia relies on its NSNWs to bolster its "escalate-to-de-escalate" framework.[24] Between Russian and Western experts, it is estimated that Russia maintains around 2,000 NSNWs.[25]

> Nuclear doctrine hardly fulfills its external and internal roles and is insufficient for assessment of nuclear policy. 'Externally,' declared deterrence principles give a rather fragmented idea of nuclear policy. . . . highly classified data 'is not presented even at closed sessions of the Russian Parliament', and nuclear posture is barely identifiable for Western observers and for Russian practitioners. . . . in the case of NSNW, Russian nuclear doctrine hardly fulfills its role either. . . . Russian thought on RND and the role of NSNW . . . is an unelaborated concept, far from being a doctrine.[26]

A 50 kt yield far outmatches that of low-yield NSNWs or TNWs and does not serve as an appropriate tool for bridging the large yield gap of escalation if Russia were to use NSNW or TNW.

The United States maintains a scalable NSNW with a yield of 0.3 to 50 kt; however, a 0.3 kt weapon likely delivers an inappropriately large yield in the context of the war in Ukraine. Put simply, the largest NSNW the United States should use to respond to a Russian NSNW or TNW aggression in Ukraine must be below 0.3 kt. As such, this example creates a direct ratio gap within traditional escalatory calculus to adequately outline the trajectory of escalation surrounding NSNW or TNW employment in the war in Ukraine. S-TNW policy considerations can provide escalation control and nuclear response solutions to this gap.

NATIONAL DEFENSE STRATEGY ANALYSIS

The 2022 NDS does not effectively prioritize or define Russian aggression in Ukraine, deterrence to prevent the use of NSNWs in Ukraine, or who qualifies as U.S. "partners."

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19 Dimitry Adamsky, "Nuclear Incoherence: Deterrence Theory and Non-Strategic Nuclear Weapons in Russia," *Journal of Strategic Studies* 37, no. 1 (September 2013): 91–134, https://doi.org/10.1080/01402390.2013.798583.

20 Ibid.

21 Ibid.

22 Ibid.

23 Ibid.

24 Bill Gertz, "Putin nuclear threat part of new escalation policy," *Washington Times*, March 2, 2022, https://www.washingtontimes.com/news/2022/mar/2/putin-nuclear-threat-part-new-escalation-policy/.

25 Adamsky, "Nuclear Incoherence"; "What are Tactical Nuclear Weapons?," Union of Concerned Scientists, June 1, 2022, https://www.ucsusa.org/resources/tactical-nuclear-weapons; Gunnar Arbman and Charles Thornton, *Russia's Tactical Nuclear Weapons: Part I: Background and Policy Issues* (Stockholm: Swedish Defense Research Agency, November 2003), https://www.foi.se/rest-api/report/FOI-R--1057--SE; and Scott Berrier, "Statement for the Record: Worldwide Threat Assessment – 2021," Defense Inelligence Agency, April 29, 2021, https://www.dia.mil/Articles/Speeches-and-Testimonies/Article/2590462/statement-for-the-record-worldwide-threat-assessment-2021/.

26 Adamsky, "Nuclear Incoherence."

The 2022 NDS articulates that:

> To deter theater attacks and nuclear coercion of Allies and partners, we will bolster the Triad with capabilities that further strengthen regional deterrence, such as F-35A dual-capable fighter aircraft (DCA) equipped with B61-12 bomb; the W76-2 warhead; and the Long-Range Standoff (LRSO) weapon. These flexible, tailored capabilities are key to ensuring that Russia's leadership does not miscalculate regarding the consequences of nuclear use on any scale, thereby reducing their confidence in both initiating conventional war against NATO and considering the employment of non-strategic nuclear weapons in such as conflict.[27]

There are two significant defects within this strategy as it pertains to the war in Ukraine: (1) the W76-2 and the Long-Range Stand Off Weapon (LRSO) are not adequately effective in managing escalation control and yield thresholds in Ukraine, and (2) the focus of these weapons, more importantly, is specifically noted to center on reducing Russian confidence for initiating a conventional war against NATO and their use of NSNWs as a means to gain tactical, operational, or strategic advantage—as opposed to deterring Russian NSNW use within the regional territory of Ukraine. Furthermore, as Ukraine is clearly not a member of NATO, these statements fall short of effectively signaling U.S. political will to intervene or counteract Russian NSNW or TNW use in Ukraine to the Russian leadership.

Within the context of RND and U.S. extended nuclear deterrence, the NDS specifies that:

> As long as Allies and partners face nuclear threats, extended nuclear deterrence will remain a pillar of regional security architectures. Effective assurances of Allies and partners is built on a shared view of the security environment and deterrence challenges; a commitment to risk- and burden-sharing; modern and effective nuclear forces; robust consultation processes; and Ally and partner confidence that the United States has the will and capability to meet its security commitments.[28]

This outlook is once again predicated on U.S. extended nuclear deterrence for allies and partners. There are no specific mentions of Ukraine as the priority, rather that NATO and the United States will multilaterally ensure safety and security within the region. However, the most crucial context of this excerpt is that the United States retains the will and capability to enforce its security guarantees. Arguably, this depends on the focus—if the United States is truly focused on NATO alone, it has performed B61-12 modernization to illustrate will and capacity. Should the United States be focused on Ukraine specifically and NSNW and TNW matching to Russian-deployed NSNWs in Belarus? Arguably, B61-12 modernization, in conjunction with the W76-2 and LRSO, is not tailored to signal politically nor strategically that the United States is willing to impose catastrophic costs on post-Russian NSNW or TNW use in Ukraine on Russian troops or occupied territories in Ukraine, Belarusian NSNW or TNW launch sites, or Russian territory which holds similar or equal political novelty as the Ukrainian territory struck by a NSNW or TNW.

IMPLICATIONS AND POLICY RECOMMENDATIONS

If Russia were to deploy a NSNW or TNW in Ukraine after a severe battlefield defeat or loss of multiple strategic territories, it could deter the international community from supporting Ukraine

27 U.S. Department of Defense, *National Defense Strategy*, 2022.
28 Ibid.

further. Additionally, a NSNW or TNW deployed within Ukraine that did not affect civilians and was contained within conventional or special operation boundaries (involving military combatants) may not elicit more than a second barrage of conventional international strikes—as the nuclear fallout of the strike would be near negligible, playing toward Russia's asymmetric advantage. It is possible that these conventional strikes would not occur on Russian territory (perhaps Belarusian territory)—as striking Russian territory may lead to a conventional world war in the same fashion that an intercontinental ballistic missile second strike on Russia following an NSNW use would lead to global thermonuclear exchanges. Once the built-up history of no nuclear use is broken, the United States is left with a broken ladder of nuclear-specific options, given its current NSNW arsenal. Multilateral decisions involving response would have to select between overmatching NSNWs or TNWs detonated in Ukraine with precision conventional munitions to thwart Russian control of strategic territory, beginning nuclear escalations on Belarusian or Russian territories, or utilizing other emerging capabilities—which may not have a common agreement of escalatory weight. Given the theoretical assumption and confines of little-to-no civilian casualties, there is not a plethora of logic supporting any nuclear escalation that harms the sovereign territories of Russia without significant, widespread, and irreversible international effects. Therefore, escalatory theory has not fully illuminated considerations for a rung that identifies conventional escalation in response to nuclear use, nor NSNW or TNW use in the void of civilian casualties.

Will NATO and the United States escalate knowing Russian strategy relies on an escalate-to-de-escalate framework? The answer to this question will likely be personality based, politically dependent, and multilaterally pending. The certainty that is available lies within policy options for the United States to deter or deny Russian NSNW or TNW use through direct unilateral signaling with multilateral regional support. These unilateral signals will offset Russian incoherence to avoid dual-sided miscalculation and signal obstruction and will articulate specific U.S. strategies focused on sovereign Ukrainian territory. These policy options are vast and modular; however, specific options are presented below that originate from strategic policy updates and political-economic options to reverse escalating to relevant S-TNW capability development and forward staging. It is worth noting Russia's lack of coherence in its escalate-to-de-escalate nuclear strategy in conjunction with its will to use nuclear weapons in the face of conventional defeats. This calls for well-planned specifications for outlining who qualifies as U.S. "partners" and revealing some details regarding what the United States is willing to put on the line to support them.

THREE-PILLAR DOWN-SELECT SIGNALS

The purpose of this tailored three-pillar down-select signal policy recommendation and approach is to provide U.S. leadership with comprehensive options that increase relative to Russian aggression or escalation within Ukraine or surrounding regions.

Pillar I: Policy Signal Approach

1. Sponsor multilateral dialogue with Ukraine, Lithuania, Poland, and Finland to discuss geopolitical thresholds for Russia to use NSNWs in Ukraine; develop subsequent multilateral actions to impose significant risk and costs on Russia.
2. Issue a modernized addendum or memorandum to the U.S. 2022 NDS and NPR that
    - pivots from NATO extended deterrence and RND to imposing NSNW and TNW costs on Belarus and Russia if the United States selects to focus on deterring Russian aggression; and

- establishes Ukraine as a U.S. partner that holds weight to U.S. and international security and economic interests, regardless of its association with NATO.

Pillar II: Enhanced Awareness and Denial Approach

3. Facilitate production and dissemination of
    - anti-access/area denial (A2/AD) sensors and systems to Ukraine, Lithuania, Finland, and Poland;
    - electromagnetic pulse (EMP)-hardened communication systems (ground-to-ground, ground-to-air);
    - radiation and thermal-protective vehicles and stand-alone vehicle shielding; and
    - radiation and thermal personal protective equipment to Ukraine and bordering states to deter Russian effects of NSNW or TNW use within tactical or operational regions.

Pillar III: Escalation Control Approach: Tailoring Nuclear Response to the Character of War

The aim of the escalation control approach is to take necessary measures if Russian aggression escalates and Pillars I and II fail to deter NSNW or TNW use in Ukraine. Pillar III allows the United States to illuminate S-TNW capability, demonstrate the will to stage it, and signal the political will to use it in response to Russian NSNW or TNW first use in Ukraine. The advantage of U.S.-developed S-TNWs and their notional staging—or, in a worst-case scenario, counter-strike use—is that the escalation risk is controlled by limiting yields of escalation to far less than Russian NSNW or TNW counterparts without failing to respond in an appropriate manner. It is, in this case, that S-TNWs serve as a unique strategic tool to impose costs and consequences on special Russian targets by showing nuclear force and effects without creating devasting civilian or collateral damage. Ultimately, this approach deters Russia from fully committing to its escalate-to-de-escalate strategy through direct and targeted yield that limits its ability to expand its regional nuclear exchanges beyond the NSNW or TNW threshold while threatening its RND.

4. Develop S-TNWs that maintain a nuclear yield lower than any NSNW or TNW in the Russian arsenal, such as
    - an S-TNW cruise missile (STNW-C) capable of delivering precision effects utilizing lower than 0.3 kt payload.
5. Develop a strategic EMP weapon (EMP-W) that can be air or vehicle delivered to enable nonnuclear effects on Russian-controlled territory, infrastructure, or aircraft and dissociate Russian command and control within Ukraine or Belarus.

SAFEGUARDS AND FAIL-SAFES

Safeguards and fail-safes are the highest consideration for the development, staging, and use of S-TNWs. The United States should seek to create effective nuclear command and control architecture, paired with technological fail-safes such as time-delayed render-safe or kill-switch technology built in to prevent misuse, loss, or negligent detonation of S-TNWs. Only with these guarantees and protections can S-TNWs be appropriately developed, relied on, and employed in tactical and operational environments.

SECOND- AND THIRD-ORDER EFFECTS: UNINTENDED ESCALATORY RISKS FROM S-TNW USE

Every political-military decision has an intended effect and unintended consequences if the intended effect is miscalculated or if an accidental or panicked response occurs. A notional tailored S-TNW response by the Unites States is calculated to produce positive effects to prevent Russian escalation in the territory of Ukraine and the surrounding NATO regions, but the use of S-TNWs is largely based on the principles of deterrence, credibility, psychology, and, most critically, the Russian escalate-to-de-escalate doctrine. As put forth by Kier Leiber and Daryl G. Press in *US Strategy and Force Posture for an Era of Nuclear Tripolarity*, "The United States should tailor its deterrent threats to the circumstances. The best way to deter nuclear attacks by regional adversaries is probably the threat of retaliatory disarming strikes—meaning counterforce strikes designed to disable the enemy's remaining nuclear forces."[29]

Negative side effects of S-TNW use, employment, or exchanges may result in fractured international norms regarding the institutional acceptance of limited nuclear war. Furthermore, S-TNW use and application can shift the center of gravity for nuclear weapons from remaining strategic tools as opposed to special or special-tactical tools that influence strategic discussions. If the Russian escalate-to-de-escalate doctrine is not utilized, S-TNWs have the ability to initiate limited nuclear war. While these second- and third-order effects are internationally costly, observers should not assume that the development of S-TNWs will lead to lowering international nuclear norms. Rather, developing an S-TNW capability will enable options within an escalatory ladder that not only fill a national capability gap but also signal a response to Russian-Belarusian nuclear escalation and development near Ukraine.

CONCLUSION

The implementation of the three-pillar approach model will effectively initiate clear and costly signals to Russia that focus on direct escalation tied to Russian aggression involving NSNW or TNW development and movement targeting Ukraine or NATO. Notably, the United States must cautiously evaluate an appropriate balance of delivering adequately weighted redlines without "overselling . . . threats [by] convincing adversaries that they will reap no reward from heading its [warning]."[30] As stated by Daniel Altman in *When Redlines Fail: The Promise and Peril of Public Threats*: "Washington cannot simply sit back and wait for hostile countries to behave in ways that harm U.S. interests. Rather, U.S. policymakers must understand that assurances matter as much as threats and that carefully calibrated redlines are almost always better than strident, dogmatic, and bluntly worded ones."[31]

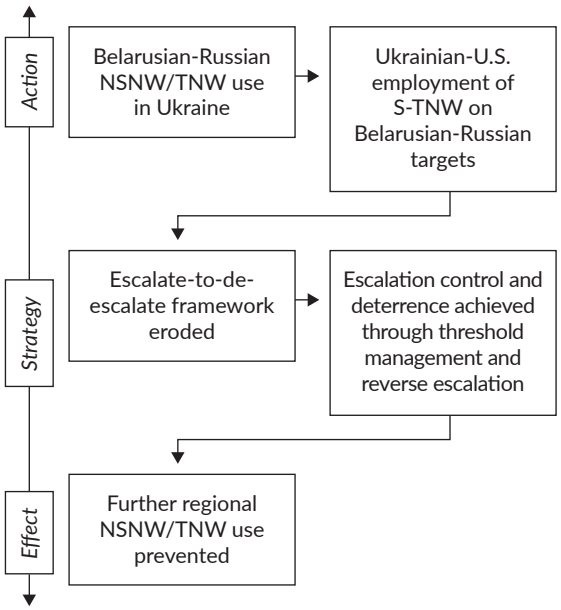
Appropriate redlines prevent Russian NSNW use in Ukraine via deterrence signaling. It is every NATO country's role to avoid nuclear Armageddon; however, with these policy recommendations and iterative approaches, the United States can clarify political will and capabilities to not only deter Belarusian-Russian NSNW or TNW aggression in Ukraine but also signal the inevitable tailored effects that the United States is guaranteed to take should Russia initiate peculiar, novel, or asymmetric nuclear use. As a second-order effect, these policy recommendations reduce Russian

29 Keir Lieber and Daryl G. Press, "US Strategy and Force Posture for an Era of Nuclear Tripolarity," Atlantic Council, September 18, 2023, https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/us-strategy-and-force-posture-for-an-era-of-nuclear-tripolarity/.

30 Dan Altman and Kathleen E. Powers, "When Redlines Fail," *Foreign Affairs*, July 13, 2023, https://www.foreignaffairs.com/articles/russia-fsu/2022-02-02/when-redlines-fail?check_logged_in=1.

31 Ibid.

Notional Response Option to Russian NSNW/TNW in Ukraine



Source: Author's own creation.

asymmetric advantage of NSNW or TNW use significantly by allowing U.S. decisionmakers to employ appropriate S-TNW or EMP-W capabilities on Russian organic or nonorganic assets without the risk of global nuclear escalation effects on a higher order of magnitude. The notional result is a complex yet managed erosion of the Russian escalate-to-de-escalate strategy and a complete reduction in further NSNW threats on Ukrainian regions and NATO allies.

The 2022 Russian Invasion of Ukraine

Nuclear Supply Chains vs. Sanctions

By Ryan Tan[1]

The United States and European countries are unlikely to collectively approve of sanctions against Russian exports of nuclear fuel assemblies and uranium in the near term despite the 2022 invasion of Ukraine. Rather than bearing the costs that cutting off Russian imports would have on domestic nuclear energy production, the United States and European countries are more likely to prefer developing alternative supply chains of nuclear fuel and enriched uranium to reduce dependence on Russian resources. This outlook is primarily based on two areas of evaluation: (1) comparison of the Russian-made reactor fuel supply chain within the European Union in 2014 following the annexation of Crimea and in 2022 following the invasion of Ukraine, and (2) the dependence of France and the United States on Russia's exports of enriched uranium. Additionally, the potential impacts to Kazakh uranium exports if trade routes for nuclear resources through Russia became unavailable were considered as an additional factor in the push for disentanglement from Russian nuclear resources.

This work utilized BACI, a database of harmonized international trade data at the product level drawn from the United Nations Comtrade Database and created by the French international economics research institute CEPII.[2] Comparisons of imports and exports were based on the trade value in U.S. dollars as reported in BACI instead of the quantity of the traded product. This evaluation only considers import and export data up until 2021, as the trade data for 2022 is incomplete within the Comtrade Database for several of the key countries presented in this work, including Australia, Canada, Namibia, Niger, and Russia.

1 Ryan Tan is currently an international security analyst at Lawrence Livermore National Laboratory. The views expressed in this paper are Dr. Tan's own and do not necessarily reflect the views of his employer (Lawrence Livermore National Security, LLC), the Department of Energy, or the U.S. government.

2 Guillame Gaulier and Soledad Zignago, "BACI: International Trade Database at the Product-Level. The 1994-2007 Version," Centre d'Etudes Prospectives et d'Informations Internationales (CEPII), October 2010, http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=37.

WESTERN COUNTRIES DIVIDED ON SANCTIONING RUSSIAN NUCLEAR EXPORTS

As of February 2024, the European Union had levied 13 sanctions packages against Russia in response to the 2022 invasion of Ukraine.[3] Rosatom, Russia's state-owned nuclear energy corporation that produces and exports nuclear fuel and enriched uranium, was excluded from each approved sanctions package. Although countries have individually taken targeted actions against Russia's nuclear industry following the invasion (e.g., Swedish utility Vattenfall AB indefinitely halted deliveries of Russian fuel in February 2022, and Finland put plans on hold for Rosatom to build the Hanhikivi 1 reactor in Pyhajoki around the same time), a few EU members along with the United States have staunchly opposed inclusion of nuclear exports in the sanction packages, which requires the unanimous approval of all EU states to implement (see Table 1).[4]

Table 1: Supporters and Opponents of Sanctions against Russian Nuclear Industry

Country	Share of Nuclear Power in Total Domestic Electricity Generation in 2021	Main Nuclear Import 2021
	Support Sanctions	
Germany	12%	Fuel, Natural and Enriched Uranium
Estonia	0%	N/A
Latvia	0%	N/A
Lithuania	0%	N/A
Poland	0%	N/A
Ukraine	55%	Fuel
	Oppose Sanctions	
Bulgaria	37%	Fuel
France	69%	Natural and Enriched Uranium
Hungary	47%	Fuel
United States	20%	Natural and Enriched Uranium

Source: Author's research based on multiple sources.[5]

3 Julia Payne, Andrew Gray and Gabriela Baczynska, "EU approves new sanctions package against Russia," Reuters, February 21, 2024, https://www.reuters.com/world/europe/eu-approves-13th-sanctions-package-against-russia-eu-sources-2024-02-21/.

4 "Vattenfall stops deliveries of Russian nuclear fuel," Vattenfall, February 24, 2022, https://group.vattenfall.com/press-and-media/newsroom/2022/vattenfall-stops-delivieries-of-russian-nuclear-fuel; "Fennovoima has terminated the contract for the delivery of the Hanhikivi 1 nuclear power plant with Rosatom," STT Info, February 5, 2022, https://www.sttinfo.fi/tiedote/fennovoima-has-terminated-the-contract-for-the-delivery-of-the-hanhikivi-1-nuclear-power-plant-with-rosatom?publisherId=68761840&releaseId=69939947; Sylvia Amaro, "Germany, Poland and others are pushing for new sanctions on Russia's nuclear energy," CNBC, April 19, 2023, https://www.cnbc.com/2023/04/19/germany-poland-and-others-are-pushing-for-new-sanctions-on-russias-nuclear-energy.html; and Victor Jack, "French-Russian nuclear relations turn radioactive," *Politico*, April 20, 2023, https://www.politico.eu/article/french-russian-nuclear-relations-radioactive-rosatom-sanctions/.

5 Daria Sito-sucic, "Poland, Ukraine call for nuclear energy sanctions against Russia," Reuters, March 2, 2023, https://www.reuters.com/world/europe/poland-ukraine-call-nuclear-energy-sanctions-against-russia-2023-03-02/; Silvia Amaro, Germany, Poland and others are pushing for new sanctions on Russia's nuclear energy," CNBC, April 19, 2023, https://www.cnbc.com/2023/04/19/germany-poland-and-others-are-pushing-for-new-sanctions-on-russias-nuclear-energy.html; Jason Hovet and Gergely Szakacs, "Sanctions on nuclear energy would harm Hungary's interests, minister says," Reuters, February 22, 2023, https://www.reuters.com/business/energy/sanctions-nuclear-energy-would-harm-hungarys-interests-minis-

Russia's political unpopularity following the invasion of Ukraine is juxtaposed with the fact that many of its critics are both entangled with Russia's nuclear economy and rely on nuclear energy for a large fraction of their domestic energy production, as shown in Table 1. According to BACI, Russia averaged 19.9 percent ± 2.8 percent of the global market for nuclear-related exports each year between 2010 and 2021, which includes reactor technology, both natural and enriched uranium, and nuclear fuel assemblies.[6] Six European countries currently utilize Russian-made reactors that require specific fuel, and numerous other Western countries rely on Russian enriched uranium along with Kazakh exports of natural uranium that are normally transported from Kazakhstan through Russia. Consequently, the success of potential sanctions on Russia's nuclear energy industry is dependent on maintaining the supply chain of nuclear resources for domestic energy production and whether alternative suppliers can be found to disentangle states from Russian nuclear exports.

RUSSIAN VVER NUCLEAR FUEL: DISENTANGLEMENT REQUIRES ALTERNATIVE SUPPLIERS

A comparison of the European response to Russia's annexation of Crimea in early 2014 and its invasion of Ukraine in 2022 reveals a correlation between a country's dependence on Russian nuclear fuel for domestic energy production and its support for sanctions against Russia's nuclear industry. Both Russian incursions invoked widespread condemnation among Western leaders and resulted in economic sanctions packages that abstained from directly sanctioning Russia's nuclear industry. However, there was little effort dedicated to sanctioning Russian nuclear commerce in 2014, and this course of action was only proposed and debated following the 2022 invasion of Ukraine. This shift in willingness within the European Union to even consider sanctioning Russia's nuclear industry, particularly as it pertains to Russian nuclear fuel, is most likely tied to the availability of alternative suppliers in 2022 compared to 2014.

2014 ANNEXATION OF CRIMEA

At the time of the Russian annexation of Crimea in early 2014, six European countries apart from Russia—Bulgaria, Czechia, Finland, Hungary, Slovakia, and Ukraine—had nuclear power plants (NPP) that operated Russian-made VVER pressurized water reactor designs (see Table 2). Although each of these states relied on nuclear energy as a major component of their domestic energy production, they did not indigenously produce fuel for these reactors and depended heavily on Russia to provide fuel assemblies as a result.

ter-says-2023-02-22/; Svetoslav Todorov, "Bulgaria President Resists Sanctions on Russian Fuel, Aid to Urkaine," February 9, 2023, https://balkaninsight.com/2023/02/09/bulgaria-president-resists-sanctions-on-russian-fuel-aid-to-ukraine/; Victor Jack, "French-Russian nuclear relations turn radioactive," *Politico*, April 20, 2023, https://www.politico.eu/article/french-russian-nuclear-relations-radioactive-rosatom-sanctions/; Ernest Scheyder and Trevor Hunnicutt, "Exclusive: U.S. utilities push White House not to sanction Russian Uranium," March 2, 2022, https://www.reuters.com/business/energy/exclusive-us-utilities-push-white-house-not-sanction-russian-uranium-2022-03-02/; Gaulier and Zignago, "BACI,"; and Madhumitha Jaganmohan, "Share of nuclear power in total domestic electricity generation in 2022, by select country," Statista, January 9, 2024, https://www.statista.com/statistics/270367/share-of-nuclear-power-in-the-power-supply-of-selected-countries/.

6 Gaulier and Zignago, "BACI."

Table 2: European VVER Units outside of Russia in 2014

Country	Name of NPP and Reactor Units	Type of Unit	Nuclear Share of Domestic Energy Production (2014)
Bulgaria	Kozloduy 5-6	VVER-1000	36%
Czechia	Dukovany 1-4	VVER-440	35%
	Temelin 1-2	VVER-1000	
Finland*	Loviisa 1-2	VVER-440	34% *(data for 2015)*
Hungary	Paks 1-4	VVER-440	53%
Slovakia	Bohunice 3-4	VVER-440	55%
	Mochovce 1-2	VVER-440	
Ukraine	Khmelnitsky 1-2	VVER-1000	49%
	Rovno 1-2	VVER-400	
	Rovno 3-4	VVER-1000	
	South Ukraine 1-3	VVER-1000	
	Zaporozhye 1-6	VVER-1000	

Note: *Finland also operated Western-made ABB and EPR reactors and imported associated fuel assemblies from Germany, Spain, and Sweden.

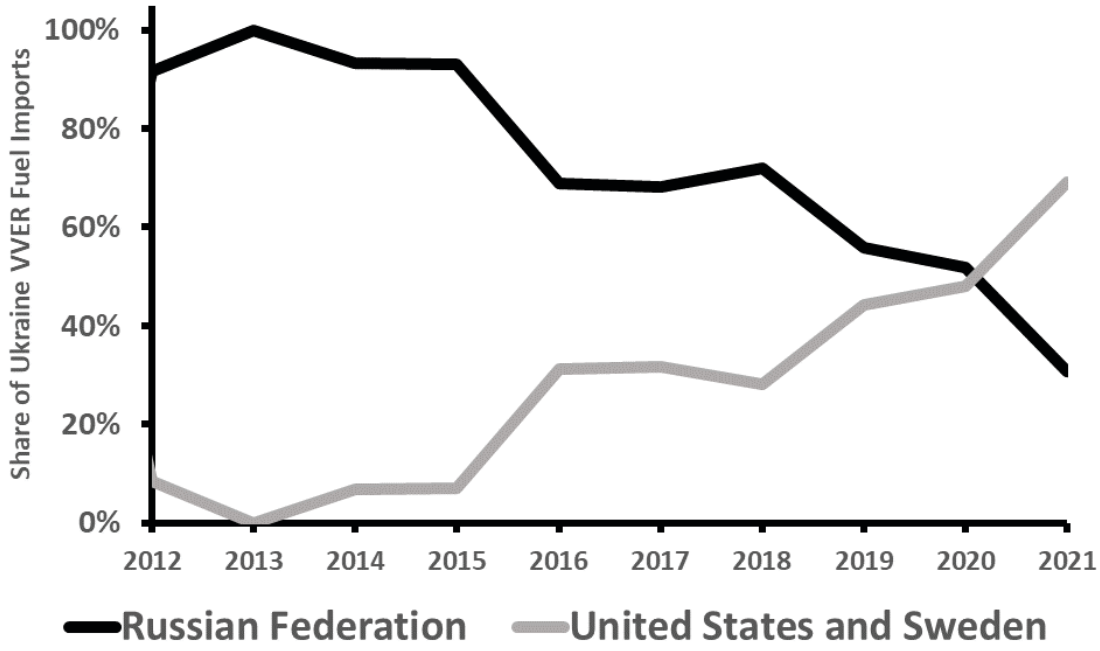
Source: Data based on the International Atomic Energy Agency's Country Nuclear Power Profiles, 2016–2019 editions.[7]

The nuclear energy industry of Ukraine itself during the annexation of Crimea demonstrated the importance of alternative VVER fuel suppliers. Although Ukraine received fuel for its VVER reactors from TVEL (a Rosatom division) in 2001, the United States and Ukraine entered into a cooperative program that same year known as the Ukraine Nuclear Fuel Qualification Program (UNFQP) to help Ukraine diversify its nuclear fuel sources for its power stations.[8] Under the UNFQP, Westinghouse (a U.S. nuclear power company) developed fuel designs for VVER-1000 reactor designs, which were first loaded into the South Ukraine 3 reactor in early 2010. Since that time, the UNFQP has allowed Ukraine to incrementally lessen its dependence on Russian fuel for its VVER-1000 reactors. When Russia annexed Crimea in 2014, Ukraine's imports of Westinghouse fuel from the Columbia Fuel Fabrication Facility in South Carolina and the Westinghouse Sweden Nuclear Fuel Factory at Västerås, Sweden, began significantly increasing in the subsequent years (see Figure 1), allowing Ukraine to incrementally disentangle its nuclear fuel supply from Russia as its political ties to Russia deteriorated.

7 Country Nuclear Power Profiles, 2016–2019 editions: "Country Nuclear Power Profiles 2017 Edition – Bulgaria," International Atomic Energy Agency, 2017, https://www-pub.iaea.org/MTCD/Publications/PDF/cnpp2017/countryprofiles/Bulgaria/Bulgaria.htm; "Country Nuclear Power Profiles 2016 Edition – Czech Republic," IAEA, 2016, https://www-pub.iaea.org/MTCD/Publications/PDF/cnpp2016/countryprofiles/CzechRepublic/CzechRepublic_tables.htm; "Country Nuclear Power Profiles 2017 Edition – Hungary," IAEA, 2017, https://www-pub.iaea.org/MTCD/Publications/PDF/cnpp2017/countryprofiles/Hungary/Hungary_tables.htm; "Country Nuclear Power Profiles 2017 Edition – Slovakia," IAEA, 2017, https://www-pub.iaea.org/MTCD/Publications/PDF/cnpp2017/countryprofiles/Slovakia/Slovakia.htm; and "Country Nuclear Power Profiles 2018 Edition – Ukraine," IAEA, 2018, https://www-pub.iaea.org/MTCD/Publications/PDF/cnpp2018/countryprofiles/Ukraine/Ukraine.htm.

8 Mark Dye, Jan Höglund, and Ulf Benjaminsson, "Diversification of the VVER fuel market," Nuclear Engineering International, September 2015, https://www.westinghousenuclear.com/media/i5pjkvtk/westinghouse-reprint-vver-fuel-nei.pdf.

Figure 1: Ukraine Nuclear Fuel Imports for VVER Reactors



Source: "BACI: International Trade Database at the Product-Level. The 1994-2007 Version," Centre d'Etudes Prospectives et d'Informations Internationales (CEPII), October 2010, http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=37.

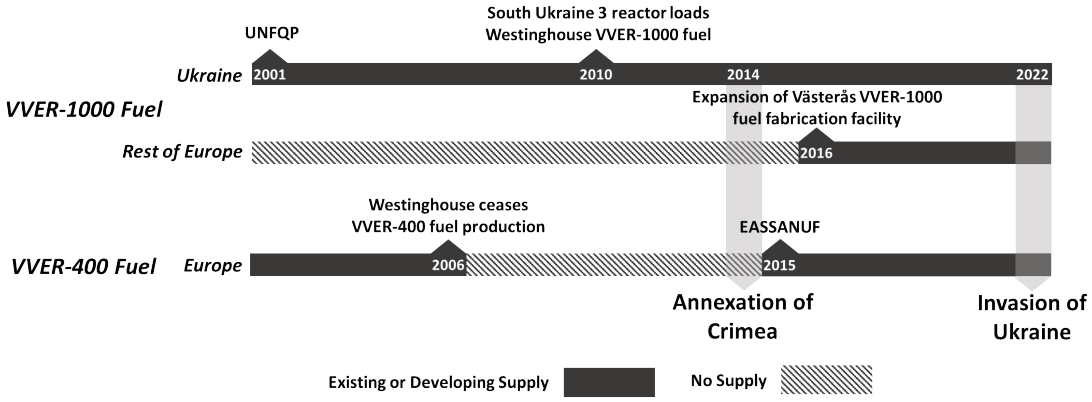
On the other hand, although the leaders of Bulgaria, Czechia, Hungary, and Slovakia all condemned Russia's military annexation of Crimea, they continued to import 100 percent of their VVER reactor fuel from Russia between 2014 and 2016, according to CEPII.[9] As shown in the timeline in Figure 2, Russia was simply the sole supplier of VVER-400 and VVER-1000 fuel to the rest of Europe at the time of Crimea's annexation. Westinghouse had already exited the VVER-400 fuel market due to unsuccessful fuel tenders in 2006 and 2007.[10] Additionally, it was not until April 2016 that Westinghouse announced the expansion of its VVER-1000 fuel at its production facility in Västerås to meet demands to diversify the fuel market, which suggests that the company did not have the production capacity to meet the fuel needs of Bulgaria and Czechia's VVER-1000 reactors at the time of Crimea's annexation.[11] Consequently, the countries in Table 2 continued to import Russian fuel out of necessity, even as they condemned Russia's military actions.

9 Gaulier and Zignago, "BACI."

10 Mark Dye, Jan Höglund, and Ulf Benjaminsson, "Diversification of the VVER fuel market," Nuclear Engineering International, September 2015, https://www.westinghousenuclear.com/media/i5pjkvtk/westinghouse-reprint-vver-fuel-nei.pdf

11 "Westinghouse expands fuel production capacity," World Nuclear News, April 29, 2016, https://world-nuclear-news.org/Articles/Westinghouse-expands-fuel-production-capacity.

Figure 2: Timeline of VVER Fuel Supply Chain Development in Europe



Source: Author's creation.

2022 INVASION OF UKRAINE

As shown in Figure 2, the West began developing alternative VVER fuel chains for European VVER reactor operators in the years following Crimea's annexation in 2014. The development of VVER-400 fuel was achieved through the 2015 consortium between Westinghouse and Eurotom known as European Supply of Safe Nuclear Fuel (ESSANUF), an effort to establish an alternative to Russian nuclear fuel for European utilities in the interest of energy security.[12] As previously mentioned, the Westinghouse facility in Västerås subsequently expanded its VVER-1000 fuel fabrication capacity in the following year. The development of these supply chains allowed for the European VVER reactor operators in Table 2 to disentangle from Russian fuel suppliers following the 2022 invasion of Ukraine.

Based on the most recent CEPII data from 2021, Bulgaria, Czechia, Hungary, and Slovakia still imported over 99.8 percent of their fuel from Russia prior to the invasion of Ukraine.[13] In the wake of the invasion, however, Czechia secured contracts with both Westinghouse and Framatome (a French nuclear power company) to provide fuel for the VVER reactors at Temelin and Dukovany in 2022 and 2023, respectively, according to ČEZ, the Czech energy company that operates the plants.[14] Furthermore, although Slovakia has continued to accept shipments from Russia since the invasion, Westinghouse agreed in August 2023 to supply fuel for the four Slovak VVER-400 reactors and fulfill Slovak prime minister Eduard Heger's pledge to "move away from the Russian source as quickly as possible."[15]

Even those EU countries in Table 1 that are staunchly opposed to sanctions of Russian nuclear resources have benefited from Western supply chains of VVER fuel. In January 2023, Bulgaria entered into agreement with Westinghouse and Framatome to supply fuel for the Kozloduy NPP beginning

12 "Westinghouse-led Consortium Prepared to Supply Fuel to VVER-440 Reactors in Europe," Westinghouse Electric Company, March 12, 2018, https://info.westinghousenuclear.com/news/westinghouse-led-consortium-prepared-to-supply-fuel-to-vver-440-reactors-in-europe.

13 Gaulier and Zignago, "BACI."

14 Jason Hovet, "Westinghouse to supply nuclear fuel to CEZ's Dukovany from 2024," Reuters, March 29, 2023, https://www.reuters.com/business/energy/westinghouse-supply-nuclear-fuel-cezs-dukovany-2024-2023-03-29/.

15 Marek Grzegorczyk, "Opportunities abound for Western nuclear firms as CEE shifts away from Russia," Emerging Europe, August 28, 2023, https://emerging-europe.com/news/opportunities-abound-for-western-nuclear-firms-as-cee-shifts-away-from-russia/; and Aneta Zachová, "Czechia replaces Russian nuclear fuel imports with US imports," Euractiv, April 3, 2023, https://www.euractiv.com/section/politics/news/czechia-replaces-russian-nuclear-fuel-imports-with-us-imports/.

in 2024.[16] Meanwhile, Hungary's opposition to sanctions is due to its close nuclear relationship with Russia, as evident by Budapest issuing permits to Rosatom in August 2022 to build two more reactors at the Paks NPP. However, that has not deterred Westinghouse from currently seeking contracts with the Paks NPP to supply fuel.[17]

The emergence of a Western supply chain in the past decade has emboldened VVER-operating EU countries to gradually disentangle themselves from Russia's nuclear industry. Although the 2014 annexation of Crimea was met with widespread condemnation among Western nations, those that operated Russian reactors had little choice but to continue importing Russian fuel since no viable alternative was available. Punishing Russia economically via its nuclear energy industry for its invasion of Ukraine in 2022 would not be possible without an alternative supply chain of VVER fuel. As the alternative VVER fuel supply chain continues to develop in the West, it will likely allow European operators of Russian reactors to gradually disentangle from Russia in the future despite gridlock on sanctions in the present.

FRANCE AND THE UNITED STATES PRIORITIZE MAINTAINING ENRICHED URANIUM SUPPLY OVER SANCTIONS

Sanctions against Russia's nuclear industry also lack the backing of the United States and France, the first- and third-largest producers of nuclear energy in the world in 2021 and 2022, respectively, despite U.S. and French support to Ukraine and its armed forces against Russian aggression.[18] Both countries' entanglement with Russia stems from imports of Russian enriched uranium, and although both the United States and France have relatively diverse suppliers of enriched uranium (Table 3), neither country appears eager to enact embargos on Russian enriched uranium that would jeopardize their respective nuclear energy economies.

France imported 26 percent of its enriched uranium from Russia in 2021, according to CEPII, and nuclear energy makes up nearly 70 percent of France's total energy production.[19] As a result, the potential domestic energy costs stemming from even a large decrease in enriched uranium supply justifies French reluctance to cut off the Russian supply. As of March 2023, France continued to receive shipments of uranium from Russia even as it faced both domestic and international pressure to halt uranium imports. Anti-nuclear NGO Greenpeace labeled the continued partnership as "scandalous," France's EU partners have criticized its continued trade with Rosatom, and Ukraine's energy minister went as far as to state that cutting off ties with Rosatom is part of France's "moral duty."[20]

Meanwhile, although the United States sanctioned three Rosatom entities in February 2023, political actions by private entities and elected officials suggest that the production of U.S.

16 "Westinghouse, Framatome to provide fuel for Kozloduy," American Nuclear Society, January 5, 2023, https://www.ans.org/news/article-4620/westinghouse-framatome-to-provide-fuel-for-kozloduy/.

17 Hetsmann Mercédesz, "Hungary to replace Russian with American nuclear fuel with EU help?," Daily News Hungary, May 22, 2022, https://dailynewshungary.com/brussels-to-help-hungary-switch-from-russian-to-american-nuclear-fuel/.

18 "Nuclear share figures, 2011-2021," World Nuclear Association, July 2022, https://world-nuclear.org/information-library/facts-and-figures/nuclear-generation-by-country.aspx; and David Vergun, "U.S., French Presidents State Support for Ukraine, Global Security," U.S. Department of Defense, December 1, 2022, https://www.defense.gov/News/News-Stories/Article/Article/3233683/us-french-presidents-state-support-for-ukraine-global-security/.

19 Gaulier and Zignago, "BACI."

20 Michael Fitzpatrick, "Greenpeace cries scandal as France continues to import Russian uranium," Radio France Internationale, March 20, 2023, https://www.rfi.fr/en/international/20230320-greenpeace-cries-scandal-as-france-continues-to-import-russian-uranium; and Vicotr Jack, "French-Russian nuclear relations turn radioactive," *Politico*, April 20, 2023, https://www.politico.eu/article/french-russian-nuclear-relations-radioactive-rosatom-sanctions/.

nuclear power remains a higher priority than punishing Russia via its enriched uranium trade.[21] According to a March 2022 report, the Nuclear Energy Institute, a trade group of U.S. nuclear power generation companies such as the Duke Energy Corporation and Exelon Corporation, actively lobbied the White House to keep Russian uranium imports exempt from sanctions, which they claim are key to keeping electricity costs low.[22] Meanwhile, although the U.S. House of Representatives introduced a bill in February 2023 to prohibit imports of Russian enriched uranium that gained bipartisan approval in the House Committee on Energy and Commerce in May, the bill contained a waiver that authorizes Russian enriched uranium imports if "no alternative viable source of low-enriched uranium is available."[23]

France and the United States have clearly prioritized sustaining domestic nuclear energy production over cutting off nuclear energy resources from Russia, and it is therefore unlikely that any proposed sanctions that will negatively impact French and U.S. nuclear energy production would have their support. However, both countries are still addressing Western entanglement with Russian nuclear resources by developing alternative supply chains rather than jeapordizing their own present nuclear energy production. The United States and France, along with Canada, Japan, and the United Kingdom, released a statement in April 2023 at the G7 Ministers' Meeting on Climate, Energy, and Environment on civil nuclear fuel cooperation that included a goal to "reduce reliance on civil nuclear and related goods from Russia" worldwide by collaborating on "uranium extraction, conversion, enrichment, and fabrication."[24]

This commitment strongly resembles the initiatives by Westinghouse and Framatome to develop alternative supplies of fuel to VVER reactors in the European Union, as described in the previous section. Both cases demonstrate a consistent trend where the United States and France have opted to help countries disentangle from Russian nuclear resources by developing alternative supply chains. Rather than pursuing sanctions, which would have forced a choice between maintaining domestic nuclear energy production and punishing Russia economically, building competition in the global market for nuclear resources allows countries that produce nuclear energy to fulfill both sets of objectives.

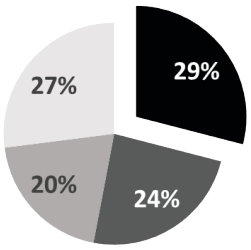
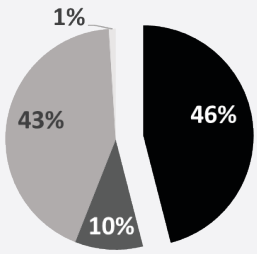
21 "The United States Imposes Additional Sweeping Costs on Russia," U.S. Department of State, February 24, 2023, https://www.state.gov/the-united-states-imposes-additional-sweeping-costs-on-russia/.

22 Ernest Scheyder and Trevor Hunnicutt, "Exclusive: U.S. utilities push White House not to sanction Russian uranium," Reuters, March 2, 2022, https://www.reuters.com/business/energy/exclusive-us-utilities-push-white-house-not-sanction-russian-uranium-2022-03-02/.

23 Prohibiting Russian Uranium Imports Act, H.R. 1042, 118th Cong. (2023), https://www.congress.gov/bill/118th-congress/house-bill/1042.

24 "New nuclear fuel agreement alongside G7 seeks to isolate Putin's Russia," Department for Energy Security and Net Zero, UK Government, April 16, 2023, https://www.gov.uk/government/news/new-nuclear-fuel-agreement-alongside-g7-seeks-to-isolate-putins-russia.

Table 3: U.S. and French Imports of Russian Enriched Uranium, 2021

	Fraction of Russia's Exports	Fraction of Global Imports	Nuclear Energy Production	Nuclear Share of Electricity Production	Enriched Uranium Imports
United States	50%	44%	772 TWh	19.6%	
France	8%	5%	363 TWh	69.0%	

Legend

Russia **Netherlands** **Germany** **Rest of World**

Source: Gaulier and Zignago, "BACI."; and "Nuclear share figures, 2011-2021," World Nuclear Association, July 2022, https://world-nuclear.org/information-library/facts-and-figures/nuclear-generation-by-country.aspx.

RESTRICTING NUCLEAR COMMERCE THROUGH RUSSIA MAY HINDER KAZAKH NATURAL URANIUM EXPORTS TO WESTERN COUNTRIES

Sanctions against Russia's nuclear industry would most likely restrict the movement of nuclear resources through Russia, which would negatively impact Kazakh exports of natural uranium. According to CEPII, Kazakhstan was the second-largest supplier of natural uranium in 2021, with 26 percent of the global share, trailing Canada (28 percent) and ahead of both Namibia (15 percent) and Uzbekistan (10 percent).[25] No other country had a share greater than 7 percent during this time, with Russia itself only having 2 percent. However, much of Kazakhstan's exports to the West transit Russia before continuing to Europe, via the northern route seen in Figure 3.[26] As a result, even if Kazakhstan itself is not sanctioned as a result of the Ukraine invasion, closure of trade routes through Russia via sanctions could be devastating to large producers of nuclear energy such as Canada, France, and

25 Ibid.

26 Ibid.; and Charles Szumski, "Kazakhstan key 'Middle Corridor' linking China to EU," Euractiv, June 16, 2022, https://www.euractiv.com/section/central-asia/news/kazakhstan-key-middle-corridor-linking-china-to-eu/.

the United States, which respectively imported 48 percent, 24 percent, and 7 percent of their natural uranium from Kazakhstan in 2021, according to CEPII.[27]

Figure 3: Trade Routes for Kazakh Uranium Exports

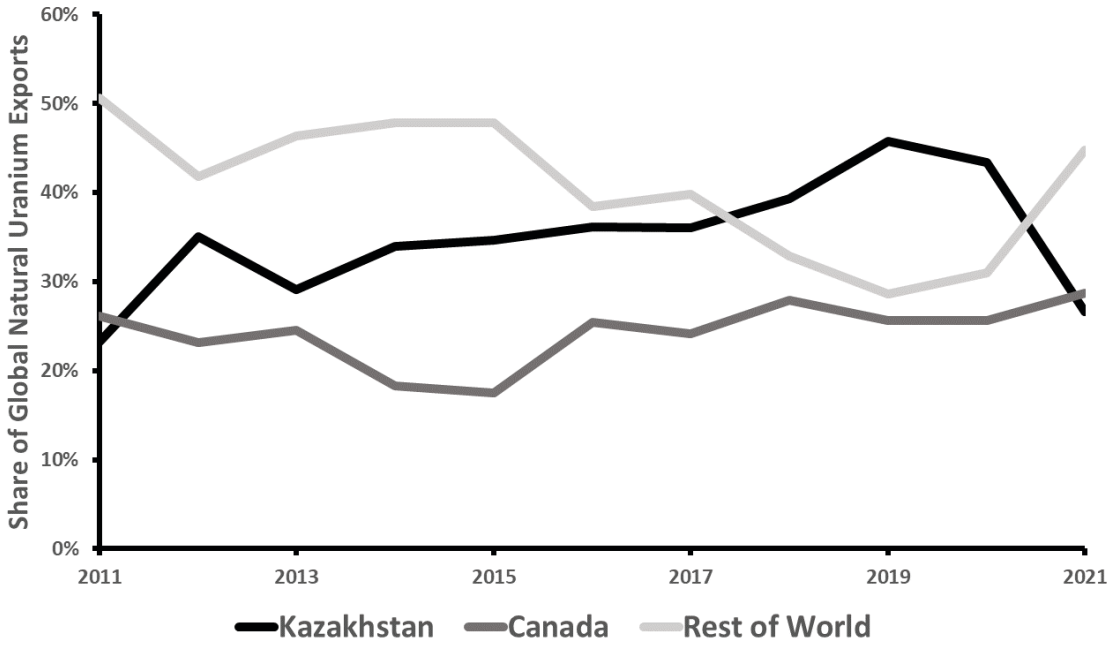
Source: Author's creation.

As seen in Figure 3, Kazakhstan and its customers may utilize the Trans-Caspian International Trade Route (TITR) through the Middle Corridor to circumvent Russia and maintain the flow of uranium exports; the first Kazakh shipment of uranium to Canada via this route was completed at the end of 2022.[28] However, trade along the TITR suffers from bottlenecks due to insufficient infrastructure. According to Gaidar Abdikerimov, the secretary general of the TITR association, transporting goods through Azerbaijan and Georgia is particularly susceptible to delays due to railway congestion as well as a lack of loading and unloading ports for ships.[29] Although this has not yet resulted in major problems being reported among Western importers of Kazakh uranium, it remains to be seen if the rate of exports through the TITR will continue to be sufficient. Despite this, potential bottlenecks along the TITR may not necessitate Western opposition to sanctions against Russia to keep the standard trade routes available. Although Western dependence on Kazakh natural uranium remains substantial, 2021 was the first year since 2011 that Kazakhstan was not global leader in natural uranium exports, and recent trends since 2019 may indicate that the dependence on Kazakh natural uranium is lessening (Figure 4).[30] If these trends continue beyond 2021 and alternative natural uranium supply chains can offset any bottlenecks that hinder Kazakh exports along the TITR, Western countries would not be required to oppose sanctions against Russia that keep Russian trade routes open. Canada will most likely be a key player in achieving this goal as the other major exporter of

27 Gaulier and Zignago, "BACI."
28 David Dalton, "Kazakhstan / Uranium Shipment Arrives In Canada Via 'Non-Russian' Route," NucNet, December 21, 2022, https://www.nucnet.org/news/uranium-shipment-arrives-in-canada-via-non-russian-route-12-3-2022.
29 Joanna Lillis, "Kazakhstan moves uranium exports through Middle Corridor," Eurasianet, January 3, 2022, https://eurasianet.org/kazakhstan-moves-uranium-exports-through-middle-corridor.
30 Gaulier and Zignago, "BACI."

natural uranium and a party to the April 2023 G7 statement that committed to diversifying global nuclear supply chains. Alternatively, if the trends reverse and Kazakhstan maintains or builds upon its status as a critical global supplier of natural uranium in the years following the 2022 invasion of Ukraine, degradations to the supply chain from Kazakhstan to the West could motivate greater Western opposition to sanctions on Russia's nuclear commerce.

Figure 4: Share of Global Natural Uranium Exports



Source: Gaulier and Zignago, "BACI."

OUTLOOK

The evaluation presented in this paper posits that Western disentanglement from Russia's nuclear energy industry following the 2022 invasion of Ukraine is contingent upon developing alternative supply chains of nuclear fuel and uranium. The responses of European countries operating VVER reactors to Russian incursions in Ukraine in 2014 and 2022 demonstrate how reducing dependency on Russian nuclear fuel led to an increased willingness to sanction those very exports. Meanwhile, although the United States and France, through the actions of policymakers and nuclear industrial players, have resisted measures to halt imports of Russian enriched uranium outright, they are instead positioning themselves as leaders in developing alternative supply chains to reduce global dependence on Russian nuclear resources. These supply chains will decrease the costs imposed on domestic nuclear energy production should Russian imports be halted, which will increase the possibility of a nuclear energy-producing country supporting sanctions against Russia's nuclear energy resources in the future. This work also supports a broader narrative where countries will likely be reluctant to penalize Russia for its incursion if the proposed actions would impose costs on their own economies. A diverse market for nuclear energy resources would therefore reduce Russia's ability to use its nuclear fuel and uranium exports as coercive leverage against other countries seeking to criticize its actions.

Changing Dynamics of U.S. Nuclear Forces, Strategy, and Alliances

NATO as a Nuclear Alliance

The Impact of Nuclear-Sharing Initiatives on Allied Defense Integration

By Andrew C. Carroll[1]

INTRODUCTION

NUCLEAR DETERRENCE AND EUROPEAN SECURITY

Nuclear weapons have historically played an important role in post–World War II European security structures During the Cold War, nuclear stockpiles on both sides of the Iron Curtain consisted of thousands of short-, medium-, and long-range missiles as well as gravity bombs intended to be deployed from aircraft. While there are far fewer nuclear weapons in Europe today, limited stockpiles remain in place for the purposes of deterrence and dissuasion under the command authority of NATO. Nevertheless, the presence of nuclear weapons in Europe is not without controversy. Since the height of the Cold War, Europe has been home to a number of fervent anti-nuclear movements calling for the removal of all U.S. weapons from European states, in addition to the disarmament of nuclear weapons controlled by France and the United Kingdom. European governments, however, including new former–Warsaw Pact NATO members in Central and Eastern Europe, largely support the presence of U.S. weapons despite domestic political opposition.[2] For all of their controversy, U.S. nuclear weapons in Europe provide a physical example of U.S. commitment to European defense. Moreover, the potential for current B61 gravity bombs to be deployed from allied, non-U.S. aircraft gives European NATO members a greater voice in alliance nuclear strategy and defense planning.[3]

1 Andrew Carroll is a nuclear and missile operations officer in the U.S. Air Force. The views expressed in this paper are those of the author and do not reflect those of the U.S. Air Force, the U.S. Department of Defense, or the U.S. government.

2 Stephen Blank, "NATO's Necessary Nuclear Debate," Atlantic Council, September 29, 2017, https://www.atlanticcouncil.org/blogs/new-atlanticist/nato-s-necessary-nuclear-debate.

3 Deputy Under Secretary of Defense for Acquisition & Sustainment, *Nuclear Matters Handbook – 2016* (Washington, DC: Department of Defense, March 2017), https://www.lasg.org/Nuclear-Matters-2016.pdf.

European states have long questioned enduring U.S. commitment to NATO, especially in the nuclear domain, and the principle of alliance extended deterrence.[4] Former U.S. president Donald Trump's focus on European defense spending as a transactional relationship for U.S. military support and comments regarding whether or not the United States would be willing to come to the military aid of European NATO allies in the event of attack have been cause for considerable concern.[5] Furthermore, Russian military resurgence in Eastern Europe, notably following the invasion and annexation of Ukraine's Crimean Peninsula, and the recent demise of the Intermediate-Range Nuclear Forces (INF) Treaty have heightened nuclear threat concerns in a number of NATO and EU member states.[6]

NATO's post–Cold War focus on peacekeeping and counterterrorism missions have led to the alliance's historical attempts to more broadly distribute nuclear responsibilities to European states through initiatives such as the Multilateral Force (MLF) and modern Nuclear Planning Group (NPG) to be frequently overlooked. The historical presence of U.S. nuclear weapons in Europe, the origins and failure of the MLF program, NATO's modern nuclear infrastructure, and unique French and UK views of nuclear deterrence all provide important context for how European leaders and security practitioners consider the further development of NATO's nuclear deterrent and seek to resist efforts to curtail European participation in the nuclear deterrence mission.

Amid growing calls for European defense integration, it is important that policymakers and publics alike understand the historical context underpinning the modern European security architecture, along with past efforts to promote greater political and military coordination among European countries. Accordingly, this paper will seek to use the history of the MLF and the development of the modern NPG as a means to highlight the centrality of nuclear sharing to the principle of extended deterrence and NATO's identity as a nuclear alliance. Through an analysis of archival material, this paper will show how the MLF initiative and development of the NPG are representative of NATO's long-standing status as a nuclear alliance, looking beyond statements contained in present-day communiqués.

The history and failure of the MLF program, in addition to the development of the NPG, can help scholars and policymakers understand not only the enduring challenges in contemporary approaches to European defense integration but also recognize potential new initiatives to strengthen NATO's nuclear deterrence posture. This includes French efforts to expand European participation in nuclear exercises and planning as well as efforts to provide conventional support to nuclear deterrence operations through programs such as NATO's Support of Nuclear Operations with Conventional Air Tactics (SNOWCAT).

NATO'S HISTORIC CHARACTER AS A "NUCLEAR ALLIANCE"

Nuclear weapons have long played an important role in NATO defense planning and strategy. Upon its formation in 1949, NATO quickly came to rely on nuclear weapons delivered by U.S. Strategic Air Command to counter military challenges from or crises related to the Soviet Union.[7] Nuclear

4 Manuel Lafont Rapnouil, Tara Varma, and Nick Witney, "Eyes Tight Shut: European Attitudes Towards Nuclear Deterrence," European Council on Foreign Relations, December 19, 2018, https://www.ecfr.eu/specials/scorecard/eyes_tight_shut_european_attitudes_towards_nuclear_deterrence.

5 Rebecca Morin, "Trump calls Macron's comments on building a European army to defend against US 'insulting'," Politico EU, November 9, 2018, https://www.politico.eu/article/trump-calls-macrons-comments-on-building-a- european-army-to-defend-against-u-s-insulting/.

6 Michael Kofman, "Drivers of Russian Grand Strategy," Stockholm Free World Forum, April 23, 2019, https://frivarld.se/rapporter/drivers-of-russian-grand-strategy-2/.

7 David N. Schwartz, *NATO's Nuclear Dilemmas* (Washington, DC: Brookings Institution, 1983).

weapons were not, however, formally codified into NATO strategy. Instead, their use was assumed, if ultimately necessary. With the formation of the Warsaw Pact by the Soviet Union in 1955, many European NATO members came to be concerned that the alliance would not be able to mount an adequate defense of Western Europe.[8] The Soviet Union and its Warsaw Pact allies, it was feared, could quickly overwhelm NATO defenses as a result of their conventional and numerical superiority in military forces, with the number of U.S. troops in Europe too small to provide for an adequate defense. At this same time, U.S. president Dwight Eisenhower sought to reduce U.S. defense spending and encourage European NATO members to spend more on their own conventional militaries.[9]

The confluence of these circumstances led U.S. and European leaders within NATO to turn to nuclear weapons to both offset perceived NATO defense shortcomings and reduce the costs of European security. Between 1957 and 1958, the United States began to allocate more nuclear weapons explicitly to Europe and NATO.[10] The alliance also began to authorize military commanders to incorporate nuclear weapons into their defense plans, with the NATO Military Committee formally adopting nuclear weapons as a core element of NATO defense strategy in Europe in documents MC 14/2 and MC 70.[11] These documents thus embodied a substantial shift in NATO policy. The United States also began to place a greater emphasis on nuclear weapons in defense planning, with the Eisenhower administration and U.S. Department of Defense making "massive retaliation" part of U.S. nuclear doctrine under the Pentagon's first Single Integrated Operational Plan, or SIOP-62.[12]

Despite NATO's new nuclear-focused defense plans, doubts among members over the enduring credibility of this strategy quickly emerged. Many European member states, in particular France, doubted whether the United States could be relied on to actually employ nuclear weapons if needed, likely putting its own cities at risk of Soviet nuclear retaliation in the process.[13] According to certain NATO leaders, the United States had no incentive to risk New York for Paris or Berlin. European states also worried over potential consequences if the United States did resort to nuclear retaliation in response to Soviet or Warsaw Pact aggression.[14] The lack of a European voice in NATO nuclear defense planning, given that the commander of NATO military forces, or SACEUR, is always an American, became a greater political issue, especially as the Eisenhower administration called for European states to bear a greater share of collective defense burdens. These aforementioned concerns, combined with the development of nuclear weapons capabilities by the United Kingdom and France, led other European states, namely West Germany, to consider developing nuclear weapons of their own.[15] In response to these issues, the United States attempted to both allay concerns over its commitment to NATO security and better distribute defense decisionmaking burdens across the alliance with the creation of multinational nuclear deterrence.

Known as the MLF, this concept envisioned submarines, and later surface ships, operated by NATO multinational crews and armed with nuclear weapons dedicated to NATO defense.[16] While initially

8 Ibid.
9 Alexander Lanoszka, *Atomic Assurance: The Alliance Politics of Nuclear Proliferation* (Ithaca, NY: Cornell University Press, 2018).
10 Schwartz, *NATO's Nuclear Dilemmas*.
11 Ibid.
12 Alexey Arbatov, "Nuclear Deterrence: A Guarantee or Threat to Strategic Stability?," Carnegie Moscow Center, March 22, 2019, https://carnegie.ru/2019/03/22/nuclear-deterrence-guarantee-or-threat-to-strategic-stability-pub- 78663#_edn19.
13 Schwartz, *NATO's Nuclear Dilemmas*.
14 Ibid.
15 Lanoszka, *Atomic Assurance*.
16 Schwartz, *NATO's Nuclear Dilemmas*.

proposed at the end of the Eisenhower presidency, the Kennedy administration furthered the concept as a means to better distribute nuclear planning responsibilities, to dissuade states such as West Germany from attaining nuclear weapons of their own, and to discourage the United Kingdom and France, both armed with nuclear weapons of their own, from developing policies outside of the purview of the United States and NATO.[17]

EUROPEAN RESPONSES TO THE MLF INITIATIVE

In the early 1960s, the countries of Western Europe understood that the NATO alliance was in a time of transition. The original design and strategies of the organization no longer matched the current global climate and the threats it presented. As UK prime minister Harold Macmillan told President Kennedy, "Great changes have taken place in the world since NATO was first established 12 years ago, and its organization needs to be remodeled to match the needs of the present situation."[18] The United Kingdom and the other European allies had long been uneasy with the Eisenhower administration's strategy of massive retaliation and welcomed any step toward a more diverse mix of nuclear strategic options. As UK minister of defense Harold Watkinson asserted: "There is no NATO concept of limited war with the Soviets."[19]

A number of leading European political figures were also keen to revive efforts at greater European defense integration and saw the MLF proposal as a potential vehicle to do so. By this time, the project of European integration had already begun through the European Coal and Steel Community (ECSC). Following World War II, Belgium, France, Germany, Italy, Luxembourg, and Italy united their coal and steel resources as a means of preventing future military conflict in Western Europe.[20] The initiative, championed under the leadership of French political economist Jean Monnet, would quickly expand to other areas with the creation of a "common market" under the European Economic Community (EEC) through the signing of the Treaty of Rome in 1957.[21] Throughout the Cold War, the EEC would continuously expand its membership beyond its founding member states.

In addition to the economic sphere, however, defense integration has long been a goal of advocates of greater European integration, namely Monnet, a leading architect of the ECSC and modern European Union.[22] Monnet was an early progenitor of the concept of neofunctionalism as a driver of integration efforts. Neofunctionalism argues that integration between independent states is best done through the slow and methodical combining of industries, organizations, and governmental functions, including potentially esoteric ones.[23] This was a main impetus behind the formation of the ECSC in the early 1950s, as European publics would likely be more amenable to integrating niche fields as opposed to traditional domains of sovereign states, including foreign, fiscal, and monetary policy. Thus would begin a process of "spillover" whereby citizens would become more accepting of expanded political integration over time after recognizing the benefits of cooperating in other,

17 Lanoszka, *Atomic Assurance*.
18 J. W. Boulton, "NATO and the MLF," *Journal of Contemporary History* 7, no. 3/4 (July–October 1972): 275–94, https://www.jstor.org/stable/259917.
19 Beatrice Heuser, "European Strategists and European Identity: The Quest for a European Nuclear Force, (1954-1967)," *Journal of European Integration History* 1/2 (1995): 61–80.
20 "The History of the European Union," European Union, https://european-union.europa.eu/principles-countries-history/history-eu_en
21 Ibid.
22 Francois Duchene, *Jean Monnet: The First Statesman of Interdependence* (New York: WWNorton, 1994), 284–88; and Pascal Fontaine, *Le Comite d'Action pour les Etats-Unis d'Europe de Jean Monnet* [The Action Committee for the United States of Europe by Jean Monnet] (Lausanne: Centre de Recherches Europeennes, 1974).
23 Arne Niemann and Philippe Schmitter, "Neo-Functionalism" in *European Integration Theory*, Antje Wiener and Thomas Diez, eds., 2nd ed. (Oxford: 2009).

smaller domains. However, such a process would have to be carried out by agreements among political leaders rather than voted for by citizens, as heightened integration among countries would likely be rejected at the ballot box due to perceived loss of national sovereignty.

With their initial success in forming the ECSC in the 1950s, European leaders forged ahead with their most aspirational integration program to date. Following the creation of the ECSC, Monnet and other leading proponents of European integration also proposed the creation of a common European Defense Community (EDC).[24] The idea of an EDC was very ambitious for its time in that it sought to go far beyond the military integration efforts seen in the creation of NATO in 1949. However, Monnet and other advocates of European integration believed that further integration could only proceed if European states eventually developed defense capabilities able to defend their national interests without support from the United States, and that such institutions had to be set in motion as quickly as possible. Accordingly, under initial plans the EDC was to provide for the creation of a European army, joint budget, and shared arms production outside of NATO. It also called for the inclusion of West Germany years before it would be permitted to rearm and become a member of NATO.

The project ultimately turned out to be short-lived, however. Due to the nature of the program, it had to be approved by all national parliaments of participating European states. In 1954, despite the urging and initiative of political leaders, the French National Assembly rejected the European army plan.[25] Following the tenets of neofunctionalism, increased military integration and loss of national sovereignty over military affairs was rejected when put to a vote. As an alternative to the failed EDC concept, the leaders of Belgium, France, Luxembourg, the Netherlands, and the United Kingdom formed a common defense group with a shared air defense command under the auspices of the Western European Union (WEU), a forerunner to the modern European Union. Proceeding with defense integration in this regard allowed political leaders to promote limited defense interdependence in areas of shared interest that would not generate political controversy, such as air defense.

Following the failure of the EDC, Monnet stepped down from his leadership role in the nascent European community and formed the Action Committee for the United States of Europe, an advocacy organization for continued European integration.[26] After achieving some success in the formation of the EEC, Monnet and the action committee turned yet again to the subject of defense integration. The committee soon came to believe that possessing an independent European nuclear deterrent would be the only way for a united Europe to operate independently of the United States, as well as the only way to prevent proliferation of nuclear weapons to states such as West Germany, which was increasingly desiring to take a leading role in European political discussions such as that afforded to France.[27] In the MLF, Monnet and the action committee saw a means to resume the stalled European defense integration process through a neofunctionalist approach that had guided previously successful integration initiatives. However, U.S. concerns over command and control and launch authority for the MLF would quickly emerge as a stumbling block in using the MLF as a neofunctional means for defense integration. Such an initiative was, however, strongly supported by

24 "Chronology: Europe's Long Road in Search of a Common Defense," Reuters, November 13, 2017, https://www.reuters.com/article/us-eu-defence-chronology/chronology-europes-long-road-in-search-of-a-common-defense-idUSKBN1DD1IK/.

25 Ibid.

26 Duchene, *Jean Monnet*.

27 "Research Memorandum REU-44 from Thomas L. Hughes to the Secretary, 'Evidence of Satisfaction or Dissatisfaction in European NATO Countries with the Lack of a Share in Ownership or Control of Nuclear Weapons'," History and Public Policy Program Digital Archive, June 05, 1963, RG 59, Entry UD-UP 131, INR/DDR, Bureau of Intelligence and Research, Reports Coordination and Review Staff, Research Memoranda 1961-1963, box 138, REU-44-RM, https://digitalarchive.wilsoncenter.org/document/134052.

leading figures in the Kennedy administration and U.S. Department of State, who viewed European integration as a key U.S. interest in maintaining European security and opposing the Soviet Union.[28]

THE MLF DEBATE AND EUROPEAN DEFENSE FISSURES

The North Atlantic Council became the forum for debate regarding the initial MLF structure in the summer of 1962. In June, Ambassador Thomas Finletter, the U.S. permanent representative to NATO, made his first official presentation of the MLF to the North Atlantic Council, where he vowed that the MLF was the only structure under which the United States could allow for a greater European role in nuclear policy planning.[29] The initiative was then furthered at a NATO defense policy meeting in September 1962 when Belgian representatives demanded a prompt NATO study on the creation of an MLF and German officials publicly pledged to contribute personnel and financial support to the program.[30] In October, Ambassador Finletter once again addressed the North Atlantic Council regarding concerns over launch authority and proliferation, as well as the launch vehicles for the force.[31] While U.S. officials had initially pledged for the MLF be composed of Polaris nuclear missile submarines under NATO command, they soon reversed course over objections from the Pentagon and Joint Chiefs of Staff. The force would instead be composed of surface naval vessels, enabling greater participation and investment from European NATO members.[32]

In order to assuage the potential European concerns that this capability change would inevitably cause, U.S. officials also proposed that nuclear use only be possible with the unanimous agreement of all NATO member states. The unanimous voting formula satisfied the worries of some Europeans, but others wanted assurance that the missiles could not be seized by a single country's national contingent on board an MLF vessel.[33] The United States dismissed the concern, noting the so-called "dual-key" nature of the nuclear command and control systems on proposed MLF assets, thereby giving U.S. officials and personnel a consistent veto over launch control. Additionally, the suggested unanimous voting formula raised serious questions regarding the deterrent credibility of the force. Many Europeans inquired as to how a committee of states could reach a firing decision in a timely manner and how the force would be reliable as a deterrent if the veto of one country could stop a launch. "If political control was extended to the point where a veto by any one-member country could prevent the use of nuclear arms, the effectiveness of the deterrent would be significantly weakened," a UK official noted.[34] Washington did not have an easy answer to these concerns except to promise that a timely voting mechanism would be devised, as well as reasoning that in almost every circumstance conceivable, the allies would be like-minded on the firing question. Moreover, the MLF would be backstopped by the independent U.S. nuclear deterrent forces, providing a timely option for nuclear response in the event of a multilateral impasse.[35]

28 "War and Peace in the Nuclear Age; Europe Goes Nuclear; Interview with George Ball, 1986," WGBH Educational Foundation, https://openvault.wgbh.org/catalog/V_C01DFF25618A450C9B8E342356B6F4DE.

29 "Research Memorandum RSB-58 from Roger Hilsman to the Secretary, 'Probable Soviet Reaction to Establishment of Multilateral NATO-Controlled MRBM Force'," History and Public Policy February 21, 1962, Program Digital Archive, RG 59, Entry UD-UP 131, INR/DDR, Bureau of Intelligence and Research, Reports Coordination and Review Staff, Research Memoranda 1961-1963, box 133, RSB-58-RM, https://digitalarchive.wilsoncenter.org/document/134047.

30 Wilfrid L. Kohl, "Nuclear Sharing in Nato and the Multilateral Force," *Political Science Quarterly* 80, no. 1 (March 1965): 88–109, https://doi.org/10.2307/2147185.

31 Schwartz, *NATO's Nuclear Dilemmas*.

32 Ibid.

33 Andrew Priest, "'In Common Cause': The NATO Multilateral Force and the Mixed-Manning Demonstration on the USS Claude V. Ricketts, 1964-1965," *Journal of Military History* 69, no. 3 (July 2005): 759–88, https://doi.org/10.1353/jmh.2005.0182.

34 Heuser, "European Strategists and European Identity."

35 Priest, "'In Common Cause'."

The United States considered this to be an optimal arrangement and essential conditions in order for the MLF initiative to take shape. Indeed, this initial proposal received support from other NATO allies, namely West Germany, which saw the offer as an opportunity to lock down U.S. nuclear guarantees to European defense while also raising its own profile as a capable and trusted ally among European NATO.[36] Other allies, however, were either cool to the proposal or rejected it outright. France was not interested in any nuclear arrangement that appeared designed to eventually bring nascent French nuclear capabilities under U.S. control.[37] On top of this, the MLF initiative divided leadership in the United Kingdom. While UK political leadership had a vested interest in maintaining their "special relationship" with the United States, they also shared French concerns that the MLF was a U.S. attempt to address European nuclear proliferation concerns by eventually subordinating UK deterrent forces under U.S. control.[38] British officials were also concerned that participating in such an initiative would damage relations with France at a time when British accession into the EEC was contingent upon the approval of France and its charismatic president, Charles de Gaulle.[39]

RENEWED MLF NEGOTIATIONS

CONTINUED PROBLEMS OF CONTROL

In 1963, the U.S. Department of State established a special office to coordinate future MLF negotiations. The office, headed by longtime diplomat and European integration advocate Livingston Merchant, was soon in contact with Monnet's Action Committee for the United States of Europe, which had a keen interest in reviving the MLF initiative in support of European integration goals.[40]

After preliminary talks in Washington in October 1963, a working group was created in Paris to discuss the political aspects of the MLF plan and future treaty. A subcommittee in Washington dealt with military aspects. West Germany, Italy, Greece, and Turkey participated in these talks, joined later by the United Kingdom, Belgium, and the Netherlands. The Paris Working Group created five subcommittees of experts whose task was to study the technical and legal aspects of the MLF initiative.[41] The action committee also remained closely involved in the process, ensuring that the MLF proposal and the concept of a European nuclear deterrent remained at the forefront of agendas for organizations such as the WEU.[42]

Under guidelines from President Kennedy based on recommendations from the U.S. National Security Council, Department of State, and the Joint Chiefs of Staff, the MLF was to be initially based around

36 Lanoszka, *Atomic Assurance*.

37 "Research Memorandum REU-25 from Roger Hilsman to Mr. Kohler, 'European Attitudes on Independent Nuclear Capability'," History and Public Policy Program Digital Archive, January 31, 1962, RG 59, Entry UD-UP 131, INR/DDR, Bureau of Intelligence and Research, Reports Coordination and Review Staff, Research Memoranda 1961-1963, box 132, REU-25-RM, https://digitalarchive.wilsoncenter.org/document/134046.

38 Ian Davis, "The British Bomb and NATO: Six Decade's of Contributing to NATO's Strategic Nuclear Deterrent," Stockholm International Peace Research Institute, November 2015, https://www.sipri.org/publications/2015/british-bomb-and-nato-six-decades-contributing-natos-strategic-nuclear-deterrent.

39 "Interview with McGeorge Bundy, Conducted by Pascaline Winland," European University Institute Historical Archives of the European Union, March 1989.

40 Duchene, *Jean Monnet*; and Fontaine, *Le Comite d'Action pour les Etats-Unis d'Europe de Jean Monnet*.

41 "Meeting Minutes, Council of Ministers of the Netherlands, 'Discussion of NATO Nuclear Force,'" Wilson Center Digital Archive, https://digitalarchive.wilsoncenter.org/document/meeting-minutes-council-ministers-netherlands-discussion-nato-nuclear-force.

42 WEU Assembly, "A NATO Nuclear Force: report submitted on behalf of the Committee on Defense by A. Duynstee, 251, 16 Oct. 1962, and Recommendation no. 83," *Proceedings WEU Assembly*, 8th session, 2d part, December 1962, III, 134–156 and IV, 21.

multinational-crewed surface naval vessels, as opposed to submarines.[43] Additionally, the United States proposed that NATO form a special committee composed of MLF participants whereby weapons could only be fired based on a unanimous vote. Before his death in November 1963, Kennedy authorized a mixed-manning experiment aboard the destroyer USS *Claude V. Rickets*.[44] By 1964, the ship, crewed by personnel from participating NATO states, proved largely successful and served as a physical example that the MLF initiative showed promise.[45]

At the same time, political negotiations showed the different attitudes of participating European NATO states toward the ultimate formation of the MLF. Italian prime minister Amintore Fanfani declared himself to be favorable to the MLF in principle but indicated that the final decision could be taken only after Italian parliamentary elections.[46] The Belgian foreign minister Paul-Henri Spaak said he was personally in support of the proposal, but also pointed out that the Belgian Senate and Ministry of Defence were strongly opposed to participation in the MLF, noting especially how such an initiative would raise Belgian defense expenditures.[47] The United Kingdom displayed a tepid attitude toward the MLF, but ultimately expressed willingness to provide nuclear warheads for continental Europe and share 10 percent of all financial costs with the project.[48] From the beginning of the project Sweden, Norway, and Denmark refused to take part in the negotiations.[49] Greece and Turkey showed their interest in the MLF but decided to participate only if the United States would provide financial assistance for the initiative.[50]

Germany–United States negotiations were more detailed and intensive than in any other European country. While Bonn accepted the Nassau Agreement as a basis for future NATO nuclear forces, the talks revealed skepticism and concern over the choice of surface ships as compared to submarines. German officials were also worried about the veto over use of nuclear weapons on German territory which other European countries would be able to exercise. However, German chancellor Konrad Adenauer eventually acceded to U.S. proposals for the future MLF by the spring of 1963. Ludwig Erhard's assumption of the chancellorship in West Germany in October 1963 strengthened the government's support the MLF project. Contrary to Adenauer, Erhard and the other West German Atlanticists were far more interested in cooperating with the United States than de Gaulle's France.

APPROACHES TO EUROPEAN SECURITY THROUGH DEFENSE INTEGRATION

The assassination of John F. Kennedy in late 1963 disrupted progress on the MLF initiative. Kennedy's successor, President Lyndon B. Johnson, was largely unaware of the MLF negotiations before assuming office. By 1964, continued progress on the MLF and a draft treaty had stalled over long-standing disputes over launch authority and its impact on the proposed force's deterrent effectiveness. Despite these apparent setbacks, Jean Monnet and the Action Committee for the United States of Europe took up a greater role in writing draft treaties and agreements, continuing to see

43 Priest, "'In Common Cause.'"
44 Ibid.
45 Ibid.
46 "Summary Record of a Meeting of the Council Held at the Permanent Headquarters, Paris, XVIe., on Friday, 11th January, 1963 at 10.15 a.m.," NATO Archives, Brussels, Belgium, Box 361.
47 Ibid.
48 Ibid.
49 Ibid.
50 Ibid.

the MLF as a means to pursue a neofunctional approach to European defense integration regardless of the absence of key European stakeholders such as France. Monnet and the action committee in particular made sure that the importance of the MLF was continuously highlighted in such forums as the WEU and its Defense Committee.[51]

The WEU had previously called for the creation of a joint European strategic nuclear force as a complement to U.S. strategic forces as early as 1959.[52] The WEU Assembly in 1962 again discussed the issue of a European nuclear force.[53] Some members of the Defense Committee considered the establishment of a European nuclear force, based on existing French and UK nuclear resources, a logical step in the creation of a European political union. The majority believed that a nuclear force for a future European community as a whole was required. The resolution called upon the member governments to make proposals to the United States "to secure the integration of allied nuclear forces into a single NATO nuclear force, possibly based on a European and an American component."[54] This procedure, however, points to a distinguishing feature of the discussions in the assembly. The debates often centered on issues of topical interest, most often as a result of U.S. initiative. This holds true for the debates in the national parliaments as well: official statements from the U.S. government on nuclear sharing within the alliance invariably elicited some debate in Europe.

POTENTIAL SOLUTION: THE MLF "EUROPEAN CLAUSE"

Members of the action committee, working closely with European MLF participants, eventually settled on what became known as the "European Clause" as a means to address concerns over continued U.S. involvement in a scheme to supposedly promote European defense integration while also reconciling persistent concerns over nuclear command and control.

Officials in the Italian Ministry of Foreign Affairs had given much thought as to how a potential MLF treaty should take into account future changes in Europe.[55] As early as July 1963, Rome had proposed a plan for a European vote, in addition to a U.S. vote, on the political control over the MLF and assigned nuclear weapons.[56] Italian representatives discussed this idea with the German government in Bonn and presented a draft amendment for a future MLF initiative treaty among participating NATO members.[57] Key to the proposal was how the MLF would adapt should a closer European political union emerge. German officials accordingly supported the proposal but considered the wording of the relationship of future European elements with other parts of the MLF force too weak. In that case, a European clause, as suggested by the Italians, might lessen the political

51 Duchene, *Jean Monnet*; and Fontaine, *Le Comite d'Action pour les Etats-Unis d'Europe de Jean Monnet.*

52 C. Barbier, "Les négociations franco-germano-italiennes en vue de l'établissement d'une coopération militaire nucléaire aux cours des années 1956-1958" [The Franco-German-Italian negotiations aimed at establishing nuclear military cooperation during the years 1956-1958], *Revue d'histoire diplomatique* 104 (1990), 100; M. Vaïsse, "Le rôle de l'Italie dans les négociations trilatérales 1957-1958 [The role of Italy in the trilateral negotiations of 1957-1958]," *Revue d'histoire diplomatique* 104 (1990), 146; and M. O'Driscoll, "Les Anglo-Saxons, F.I.G. and the Rival Conceptions of 'Advanced' Armaments Research & Development Cooperation in Western Europe, 1956-1958," *Journal of European Integration History* 4 (1998), 108; and G. Soutou, *L'alliance incertaine. Les rapports politico-stratégiques franco-allemands 1954-1966* [The uncertain alliance: Franco-German politico-strategic relations 1954-1966] (Paris: Fayard, 1996), 55–78.

53 WEU Assembly, "A NATO Nuclear Force."

54 Ibid.

55 Ine Megens, "The Multilateral Force as an Instrument for a European Nuclear Force?" in *NATO and the Warsaw Pact: Intra-Bloc Conflicts*, eds. V. Papakosma and A. Heiss (Kent, OH: Kent State University Press, 2008), 106.

56 Ibid.

57 "Annex to analysis by SMD on Proposal to assign to NATO Italian Polaris-armed Ships," History and Public Policy Program Digital Archive, June 13, 1963, Istituto Luigi Sturzo, Archivio Giulio Andreotti, Box 1009, Subseries - N/A, Folder 2, https://digitalarchive.wilsoncenter.org/document/177875.

impact of a multilateral surface fleet and weaken the bonds between the United States and Europe. Germany also favored a shorter and generally worded formula, which would make the acceptance of such a clause much easier among potentially skeptical European member states such as the United Kingdom and the Netherlands.[58]

After several months of bilateral talks between the Italian and German delegations, along with the action committee, the final draft of the so-called European clause was presented to the Paris Working Group in June 1964.[59] The political implications of the amendment were far reaching. Were a European political union with authority over national security matters to be established, the clause envisaged a review of the proposed MLF treaty to meet the new political circumstances.[60] It meant that a European union, in which France would take part, might lead to adaptation of the MLF treaty, to which France and any other nonparticipating country would not be a member. Such an arrangement would also allow for the future inclusion of the United Kingdom in any European political integration initiative, especially given the recent veto of UK membership in the EEC by de Gaulle. This would ultimately mean subordination of independent UK and French nuclear deterrents to an integrated European defense authority ostensibly outside of U.S. and NATO control, should such an arrangement be reached. Moreover, it anticipated a U.S. willingness to relinquish the considerable operational control it enjoyed through NATO as a means to pursuing a more closely integrated Europe.

The most critical comments on the proposed "European Clause" framework came from the Dutch and the UK representatives, who expressed doubts as to whether it was appropriate to refer to future developments that might necessitate bringing about changes in the treaty if the aim of the MLF project was to strengthen transatlantic ties.[61] Transatlantic cooperation might crystallize into two pillars, European and NATO, in the future, but this was not yet the case. They argued that European integration in the field of defense was a distant prospect at best, noting past failed initiatives such as the EDC, and that to refer to these issues in the treaty was premature.[62] Other representatives had fewer objections or believed that it might be important to refer to closer European cooperation in order to sway public opinion in Europe. During the discussions, German ambassador Wilhelm Grewe and Italian ambassador Adolfo Alesandrini made it clear that their support for a European clause was partly brought about by internal political considerations. Both ambassadors also pointed out that they had been guided by a recent resolution of the Action Committee for the United States of Europe.[63]

IMPACT OF THE MLF INITIATIVE ON NATO NUCLEAR POSTURE

West Germany was the only European government that kept the MLF on NATO's agenda by 1965.[64] For Bonn, it remained crucial to strengthen the link between the Atlantic partners, particularly in relation to the apparent rise of U.S.-Soviet détente and the withdrawal of France from the NATO integrated military command structure. With support for the MLF stagnating in European and North American capitals by 1965, the United States took new initiative to address persistent burden-sharing concerns in NATO's nuclear policy framework. Secretary of Defense Robert McNamara proposed the

58 Multilateral Force Working Group, *Second Summary*, 146.
59 Megens, "The Multilateral Force as an Instrument for a European Nuclear Force?"
60 Ibid.
61 "Summary Record of a Meeting of the Council Held at the Permanent Headquarters, Paris, XVIe., on Tuesday, 15th December 1964 at 10.15 a.m.," NATO Archives, Brussels, Belgium, Box 359.
62 Ibid.
63 Megens, "The Multilateral Force as an Instrument for a European Nuclear Force?"
64 "Summary record of a private meeting of the Council held on Wednesday, 24th March, 1965 at 10.15 a.m.," NATO Archives, Brussels, Belgium, Box 65, File 13.

creation of the NATO NPG to address collective defense decisionmaking in the nuclear realm. With the exception of France, the NPG allowed for greater consultation among member states regarding employment of nuclear weapons.[65] The NPG was also unique in that it was placed on par in terms of authority with the North Atlantic Council, NATO's principal decisionmaking body. This differed from other alliance subcommittees, such as the Military Committee, which remain subordinate to the North Atlantic Council. The NPG remains in place today, allowing all members a forum for discussion and coordination on nuclear policy matters, although it does not include France, which has still refused to join despite rejoining the NATO military command structure in 2009.

The failure of the MLF initiative and the successful creation of the NPG ultimately underscored the importance of nuclear deterrence to NATO collective defense planning. While not formally articulated, the MLF negotiation process and resulting NPG formation emphasized the long-standing nuclear character of the transatlantic alliance. Moreover, the involvement of key individuals and groups such as Jean Monnet and the Action Committee for the United States of Europe highlighted the key role nuclear deterrence played in European defense cohesion within NATO. These early efforts not only helped to institutionalize the nuclear character of the NATO alliance, but also firmly linked extended deterrence with nuclear sharing. Nuclear sharing remains the basis of extended deterrence commitments today, as well as a basis for further European defense cooperation in the nuclear domain through programs such as the SNOWCAT initiative.[66]

NEW IMPETUS FOR NATO NUCLEAR DETERRENCE

Amid Russia's 2022 invasion of Ukraine, NATO's forward-deployed nonstrategic nuclear weapons have been given a renewed focus. No longer are these weapons merely instruments of political symbolism; they are also a potent deterrent to potential Russian employment of this same class of weapons.[67] Despite years of drawdown, nonstrategic nuclear weapons have been maintained as an element of NATO defenses and strategy because they provide NATO military commanders with multiple response options to threats and crises.[68] Additionally, they demonstrate alliance solidarity and shared resolve.[69] Despite their potential political volatility, European governments continue to host these weapons because of their deterrent value, and the greater role they afford host nations in NATO nuclear planning processes, which are key to maintaining alliance competency in the face of resurgent nuclear threats. Proposed upgrades to the U.S. B61 gravity bombs—which make up the entirety of NATO's forward-deployed nuclear arsenal—made by both the Obama and Trump administrations' Nuclear Posture Reviews will only strengthen this deterrent and make it more valuable.[70]

65 Thomas M. Nichols, Douglas T. Stuart, and Jeffrey D. McCausland, eds., *Tactical Nuclear Weapons and NATO* (Carlisle Barracks, PA: U.S. Army War College, 2012).

66 Rose Gottemoeller, "NATO Nuclear Policy in a Post-INF World," (speech, NATO, Oslo, Norway, September 9, 2019), https://www.nato.int/cps/en/natohq/opinions_168602.htm.

67 John J. Klein, "The Case for Tactical Nuclear Weapons," Stratfor Worldview, November 25, 2014, https://worldview.stratfor.com/article/case-tactical-nuclear-weapons.

68 Albert J. Mauroni, "Why Tactical Nuclear Weapons are Still a Thing," Defense One, October 4, 2017, https://www.defense-one.com/ideas/2017/10/why-tactical-nuclear-weapons-are-still-thing/141540/.

69 Walter Pincus, "NATO's Atomic Stockpile: Primary Political Weapons," *Washington Post*, December 11, 1978, https://www.washingtonpost.com/archive/politics/1978/12/11/natos-atomic-stockpile-primarily-political-weapons/9fceeb3b-3b62-484b-8f2b-26ecf0f35616/.

70 U.S. Department of Defense, *2018 Nuclear Posture Review* (Washington, DC: Department of Defense, February 2018), https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF.

NATO NUCLEAR DETERRENCE INTEGRATION FOR A NEW ERA

In order to assuage concerns regarding U.S. commitment to NATO's extended nuclear deterrence mission, as well as growing calls in European states to end support for forward- deployed U.S. nuclear forces through efforts such as the Nuclear Ban Treaty, European NATO member and partner states should look to the lessons of the MLF and early NPG era to reinvigorate NATO's nuclear deterrence posture through enhanced cooperation.

In addition to continuing support for NATO's existing extended nuclear deterrence framework, European allies and partners should revisit an initiative initially proposed by French president Emmanuel Macron. In early February 2020, President Macron gave a much-anticipated speech regarding nuclear deterrence and France's future nuclear posture as the European Union's sole remaining nuclear power following the departure of the United Kingdom from the regional bloc. The speech, a tradition for French presidents since Charles de Gaulle, was notable in that Macron proposed that European states should have the opportunity to take a greater role in French nuclear deterrence exercises and policy planning in support of the drive to build a common European defense culture.[71] While further details of the proposed initiative were quickly overshadowed by the onset of the global Covid-19 pandemic, its proposal raises the question as to whether such an initiative could correct the noted shortcomings of the NATO MLF program and bolster NATO's status as a nuclear alliance through a more capable European nuclear deterrent pillar of the alliance.

As France is not a member of the NATO NPG and retains a high degree of independence in defense affairs, this program, on the surface, appears to correct some of the challenges that plagued the MLF program. Moreover, should France be able to build upon existing defense cooperation treaties with the United Kingdom, such as the Lancaster House Treaties (which already include provisions regarding nuclear cooperation), as well as defense programs outside of an explicitly EU framework, such as the European Intervention Initiative, which includes the United Kingdom, it is possible that the appropriate multilateral support could be achieved to move toward greater defense integration in the nuclear domain outside of a U.S.-centric framework.[72] At the same time, NATO can take advantage of the momentum provided by the proposed French initiative to strengthen the deterrent capabilities of its nonnuclear members through bolstering capabilities provided by the existing SNOWCAT program and emerging conventional-nuclear integration initiatives. Given that a majority of NATO member states will continue to rely on aircraft such as the F-16 despite improved Russian air defense systems being deployed across Europe, NATO must have the capability to hold targets at risk at range with minimal risk to flight crews while also supporting continued NATO air dominance in Europe.[73] NATO's continued air superiority in Europe is crucial, as it represents the alliance's best offset in the event of attack to buy time before adequate reinforcements could arrive under Article Five guarantees. Moreover, NATO air power, even in the conventional realm, is a potent deterrent against attacks from potential adversaries such as Russia.

71 Tara Varma, "The Search for Freedom of Action: Macron's Speech on Nuclear Deterrence," European Council on Foreign Relations, February 7, 2020, https://www.ecfr.eu/article/commentary_the_search_for_freedom_of_action_macrons_speech_on_nuclear_deter.

72 Alice Pannier, *Rivals in Arms: The Rise of UK-France Defence Relations in the Twenty-First Century* (Montreal: McGill-Queen's University Press, 2020), https://doi.org/10.2307/j.ctv18sqzcr.

73 "Europe," in International Institute for Strategic Studies (IISS), *The Military Balance* (London: IISS, 2019): 66–165, https://www.tandfonline.com/toc/tmib20/119/1?nav=tocList; and Ian Williams, "The Russia-NATO A2AD Environment," CSIS, *Missile Threat*, January 3, 2017, https://missilethreat.csis.org/russia-nato-a2ad-environment/.

Improving standoff capabilities through a new conventional deterrent in the form of the Joint Air-to-Surface Standoff Missile (JASSM) and its longer-range variant, the JASSM-ER, would provide such a conventional deterrent and offset capability.[74] A NATO-wide procurement of JASSM systems, which proved their effectiveness in Syria in 2018, would not only allow NATO non-stealth fourth-generation aircraft to operate outside of Russian air defense networks but also counter similar Russian capabilities currently in development.[75] Such a weapon would also enhance NATO unity in that it is politically possible to procure, being a conventional weapon, and is already in use by a number of NATO states, namely Poland for use by its F-16 and future F-35 fleet.[76] If more NATO member states were able to procure JASSM and JASSM-ER systems from the United States, NATO resources could contribute to new targeting systems, such as satellites, to enhance deterrent capability and weapon precision.[77] This is a capability which states such as Poland have claimed they desperately need, and their further use represents an avenue to promote integration not only within NATO but within the European Union's shared defense spending programs such as the Permanent Structured Cooperation Initiative (PESCO).

At the same time, NATO could also bolster its deterrent capabilities without tactical nuclear weapons by assisting member states in ending reliance on Russian and Soviet-era military equipment. NATO has already begun to act in this regard, with states including Slovakia and Romania recently acquiring modernized F-16s from the United States, with Bulgaria soon to follow.[78] By upgrading aircraft and precision targeting systems, NATO can better distribute defense burdens across the alliance while also maintaining the effective deterrence and political symbolism previously afforded by tactical nuclear weapons.

However, as previously stated, the full details of such a program remain to be seen, including the full extent of cooperation, notably concerning key issues that plagued the MLF initiative, including political command and control as well as nuclear launch authority. Moreover, support for nuclear nonproliferation among European countries, a security goal inculcated in part from experience with the MLF program negotiations, remains high; thus it is an open question as to whether such an initiative, however promising, can move past historical impasses to help bolster NATO's nuclear dimension through a stronger European nonstrategic nuclear deterrent pillar of the alliance. Accordingly, NATO and the United States should aim to continue working to enhance cooperation with France to assist in sharing strategic nuclear targeting responsibilities, especially as U.S. nuclear forces contend with emerging nuclear targeting challenges emanating from the People's Republic of China. While this will not be an immediate transition, it is a plausible goal based on trends and lessons learned from past programs such as the MLF.

74 Hans Kristensen, "Forget LRSO; JASSM-ER Can Do the Job," Federation of American Scientists, December 16, 2015, https://fas.org/publication/lrso-jassm/.

75 John A. Tirpak and Brian Everstine, "Syria Strike Marks Combat Debut for JASSM-ER," *Air Force Magazine*, April 15, 2018, http://www.airforcemag.com/Features/Pages/2018/April%202018/Syria-Strike-Marks-Combat- Debut-for-JASSM-ER.aspx; and Dave Johnson, *Russia's Conventional Precision Strike Capabilities, Regional Crises, and Nuclear Thresholds* (Livermore, CA: Lawrence Livermore National Laboratory, February 2018), https://cgsr.llnl.gov/content/assets/docs/Precision-Strike-Capabilities-report-v3-7.pdf.

76 Maksymilian Dura, "Poland Needs Satellites and Targeting Systems for JASSM Missiles," Defence24, January 10, 2017, https://www.defence24.com/poland-needs-satelites-and-targeting-system-for-jassm-missiles.

77 Ibid.

78 Joe Gould, "With F-16 Buy, Slovakia Cutting Off Russian Hardware," Defense News, November 18, 2018, https://www.defensenews.com/global/europe/2018/11/18/with-f-16-buy-slovakia-cutting-off-russian-hardware/; Igor Bozinovski, "Romania to Buy Additional F-16s," Janes, March 13, 2019, https://www.janes.com/article/87199/romania-to-buy-additional-f-16s; and Georgi Gotev, "Bulgarian PM: Pilots Tell Me F-16 is Best," Euractiv, December 14, 2018, https://www.euractiv.com/section/defence-and-security/news/bulgarian-pm-pilots-tell-me-f-16-is-best/.

Balance of Power or a New Arms Race?

Arguments for and against Adding a Sea-Launched Nuclear Cruise Missile to the U.S. Arsenal

By Sydney Hamilton[1]

The Trump administration's Nuclear Posture Review (NPR), released in February 2018, announced that the United States would pursue a nuclear-armed sea-launched cruise missile (SLCM-N).[2] The 2018 NPR suggested that the SLCM-N would provide a nonstrategic regional presence and an assured response capability. The administration also argued that it would provide a response to Russia's noncompliance with the Intermediate-Range Nuclear Forces (INF) Treaty:

> The United States will pursue a nuclear-armed SLCM, leveraging existing technologies to help ensure its cost effectiveness. SLCM will provide a needed non-strategic regional presence, an assured response capability, and an INF-Treaty compliant response to Russia's continuing Treaty violation. If Russia returns to compliance with its arms control obligations, reduces its non-strategic nuclear arsenal, and corrects its other destabilizing behaviors, the United States may reconsider the pursuit of a SLCM.[3]

The Biden administration's NPR, released in March 2022, cancels the SLCM-N project, arguing that the W76-2 low-yield submarine-launched ballistic missile (SLBM) gives the appropriate deterrence contribution:

1 Sydney Hamilton is an analyst with SAIC. The views expressed in this paper are those of the author and do not reflect the official policy or position of the Department of the Navy, the Department of Defense, or the U.S. government.

2 The citation of external documents does not constitute endorsement by the U.S. Department of Defense (DOD) of the linked material, or the information, products, or services contained therein. The DOD does not exercise any editorial, security, or other control over the information you may find at these locations. The views expressed in this article are those of the author and do not reflect the official policy or position of the DOD or the U.S. government.

3 U.S. Department of Defense, *Nuclear Posture Review* (Washington, DC: Department of Defense, February 2018), 55, https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF.

> We are cancelling the nuclear-armed Sea-Launched Cruise Missile (SLCM-N) program. The 2018 NPR introduced SLCM-N and the W76-2 to supplement the existing nuclear program of record in order to strengthen deterrence of limited nuclear use in a regional conflict. We reassessed the rationale for these capabilities and concluded that the W76-2 currently provides an important means to deter limited nuclear use. Its deterrence value will be re-evaluated as the F-35A and LRSO are fielded, and in light of the security environment and plausible deterrence scenarios we could face in the future. We concluded SLCM-N was no longer necessary given the deterrence contribution of the W76-2, uncertainty regarding whether SLCM-N on its own would provide leverage to negotiate arms control limits on Russia's NSNW, and the estimated cost of SLCM-N in light of other nuclear modernization programs and defense priorities.[4]

This has driven a significant policy debate among policymakers, the think tank community, and academia. Of course, there are many arguments both for and against adding the SLCM-N to the U.S. nuclear arsenal, and no solution is perfect. Several questions guide this debate, particularly regarding whether the SLCM-N would do the following:

- lower the nuclear threshold;
- change Russian war planning;
- start a new arms race between the United States and Russia;
- provide assurance in the Pacific;
- be redundant when considering the whole of the U.S. nuclear arsenal; and
- bring Russia to the arms control negotiation table.

This research outlines arguments both for and against adding the SLCM-N to the U.S. nuclear arsenal. Proponents of adding the capability to the arsenal argue that it is necessary for assuring U.S. allies in the Pacific, shaping adversaries' perceptions in ways that reinforce deterrence, and forcing Russia back to arms control negotiations. Opponents of the proposition argue that the SLCM-N is a redundant weapon, that it would do nothing to encourage Russia to negotiate new arms control agreements, and that it could push the United States and Russia into a new arms race. Opponents also argue that the SLCM-N could lower the United States' nuclear threshold, thereby making nuclear weapons employment more likely. Based on these arguments, the conclusion recommends reconsidering the cancellation of the SLCM-N.

WOULD THE SLCM-N LOWER THE NUCLEAR THRESHOLD?

One major criticism, both from domestic opponents and potential adversaries, is that adding the SLCM-N to the U.S. arsenal would lower the nuclear threshold. The 2018 NPR did not expand the situations in which nuclear weapons would be employed, but it did clarify the existing use cases:

> The United States would only consider the employment of nuclear weapons in extreme circumstances to defend the vital interests of the United States, its allies, and partners. Extreme circumstances could include significant non-nuclear strategic attacks. Significant non-nuclear strategic attacks include, but are not limited to, attacks on the U.S., allied, or

4 U.S. Department of Defense, *Nuclear Posture Review* (Washington, DC: Department of Defense, October 2022), 20, https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.PDF.

> partner civilian population or infrastructure, and attacks on U.S. or allied nuclear forces, their command and control, or warning and attack assessment capabilities.[5]

U.S. policy has remained the same in this instance, so the United States is not deliberately lowering the nuclear threshold. But would the addition of the SLCM-N lead another adversary to employ nuclear weapons earlier than they would have if the SLCM-N were not in the U.S. nuclear arsenal? Theoretically, the addition of the SLCM-N would fill a perceived gap in the U.S. nuclear arsenal below the level of a strategic exchange. Rather than lowering the threshold for nuclear war, the SLCM-N would send the message that the United States will not allow itself or its allies or partners to be subjected to limited nuclear attack or significant nonnuclear strategic attack without a credible response, likely raising the nuclear threshold.

WOULD THE SLCM-N CHANGE RUSSIAN WAR PLANNING?

To convince Russia that limited nuclear employment could not provide it coercive military advantage, the United States could use the SLCM-N to shape Russian perceptions of theater and strategic correlations of forces and means (COFM).[6] COFM is a Russian analytic framework that "allows comparison of various forces' relative combat power and effectiveness in specific mission sets against each other."[7] The Russian General Staff uses COFM to measure how its forces stack up against an adversary in general as well as in specific potential contingencies.[8] The SLCM-N could have tilted the strategic and theater COFMs in ways that would erode Russian confidence in their decisive edge in nuclear brinkmanship. The presence of the SLCM-N in the U.S. nuclear arsenal would likely affect Russian planning because they might perceive the weapon system as providing the United States with an additional option for deterring Russian limited nuclear or significant nonnuclear strategic attacks, which in turn might increase U.S. deterrence credibility. If Russian leaders believed that the United States might hesitate to employ intercontinental ballistic missiles (ICBMs) or SLBMs in such scenarios, and the response timelines of U.S. bombers are not prompt, this could therefore create windows of opportunity for Russian diplomatic or military maneuver following limited first nuclear use in regional conflict. Moreover, U.S. dual-capable fighter aircraft (DCA) would be challenged to penetrate Russian integrated air defense coverage. In this case, development and deployment of the SLCM-N could disabuse Russia of the idea that it possesses a coercive advantage over the United States.

The SLCM-N could also impose costs on Russia by forcing it to counter this weapon system, whether through missile defense systems or new weapons, or otherwise accept the risk of vulnerability. This is a cost that Russia might not want to bear and could motivate Russian leaders to negotiate new arms control agreements. Russia's theater nuclear capabilities are not currently limited by any treaty, and Russia is not likely to negotiate such limits if the United States does not have a theater capability that concerns Russia enough to desire its limitation in return.[9]

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5 U.S. Department of Defense, *Nuclear Posture Review* (2018), 21.

6 Clint Reach, Vikram Kilambi, and Mark Cozad, *Russian Assessments and Applications of the Correlation of Forces and Means* (Santa Monica, CA: RAND, 2020), https://www.rand.org/pubs/research_reports/RR4235.html.

7 Joseph McCarthy, "Combat Values: A Unified Input for Correlation of Means and Forces," *Phalanx* 53, no. 4 (December 2020): 34–41, https://www.jstor.org/stable/26964304.

8 "English translation of the 2015 Russian National Security Strategy," Russia Matters, December 31, 2015, https://www.russiamatters.org/node/21421.

9 See Office of the Under Secretary of State for Arms Control and International Security, "Strengthening Deterrence and Reducing Nuclear Risks: The Supplemental Low-Yield U.S. Submarine-Launched Warhead," U.S. Department of State, *Arms Control and International Security Papers* 1, no. 4 (April 2020): 2, https://www.state.gov/wp-content/uploads/2020/04/T-Paper-Series-4-W76.pdf; and U.S. Department of Defense, *Nuclear Posture Review* (2018), 54.

Currently, Russia appears to believe that it has the upper hand when it comes to controlling escalation following potential limited nuclear use. This makes it easier for Russia to plan limited nuclear options that exploit a narrower set of U.S. options: pursuing a nonnuclear response that might be insufficiently cost-imposing, employing DCA in a retaliatory nuclear strike that would need to penetrate potentially robust integrated air defenses, escalating to strategic nuclear employment or large-scale conventional strikes that U.S. leaders might perceive as excessively provocative, or capitulating to Russia's demands to end the conflict. If the SLCM-N were deployed capability, Russian leaders might be less confident that they possess a decisive coercive advantage, potentially making them less sure of the prospects for aggression in the first place. The SLCM-N would introduce a measure of uncertainty in this regard. Thomas Schelling argues:

> As a rule, one must threaten that he *will* act, not that he *may* act, if the threat fails. To say that one *may* act is to say that one *may not*, and to say this is to confess that one has kept the power of decision—that one is not committed. To say only that one *may* carry out the threat, not that one certainly will, is to invite the opponent to guess whether one will prefer to punish himself and his opponent or to pass up the occasion.[10]

For this strategy to work, the United States would need to adopt a declaratory policy that it would employ nuclear weapons if subjected to a limited nuclear attack, as done in the 2018 NPR.[11] Following this logic, the United States would be forced to respond in kind if Russia conducted a limited nuclear attack. However, if Russian leaders believed that the United States would follow through on this threat, they would be less likely to employ such attacks. Opponents of the SLCM-N often level the accusation that the platform introduces a discrimination problem because it will be deployed on a dual-use vessel alongside conventional weapons. The U.S. Department of State argues that Russian early-warning systems would enable Russian senior leadership to assess the scale of an attack.[12] This logic will likely be extended to China in the future as well.

WOULD THE SLCM-N START A NEW ARMS RACE BETWEEN THE UNITED STATES AND RUSSIA?

It is unlikely that the addition of the SLCM-N to the U.S. nuclear arsenal would trigger an arms race between the two countries. Russia cannot engage in such a race due to a lack of resources, and this gap has been further exacerbated by the technology export sanctions resulting from the war in Ukraine. Plus, Russia has already built up a decidedly superior number of nonstrategic nuclear weapons. The United States does not have to race because it does not need the same number of weapons as Russia to deter an attack.

When discussing the SLCM-N, one would be remiss not to discuss its predecessor: the nuclear-armed Tomahawk land attack missile (TLAM-N). The TLAM-N was an intermediate-range, subsonic cruise missile launched from U.S. Navy ships and submarines that was capable of carrying a W80 warhead approximately 2,500 kilometers. It reached initial operating capability in 1984 and was deployed at sea until President George H. W. Bush issued his 1991 Presidential Nuclear Initiatives at the end of

10 "The Threat That Leaves Something to Chance" in Thomas Schelling, *The Strategy of Conflict* (Cambridge, MA: Harvard University Press, 1960), 187.
11 U.S. Department of Defense, *Nuclear Posture Review* (2018), 21.
12 Office of the Under Secretary of State for Arms Control and International Security, "Strengthening Deterrence and Reducing Nuclear Risks," 6.

the Cold War.[13] TLAM-N assets were retained in non-deployed storage, with an option to redeploy them as needed, until President Barack Obama's 2010 NPR directed their retirement, which was completed in 2013.[14]

Much like the TLAM-N, the SLCM-N would provide limited theater nuclear response options below the level of a general nuclear exchange.[15] Currently, the three legs of the triad are strategic arms as defined by the New Strategic Arms Reduction Treaty (New START). As SLCMs are not accountable under New START, the SLCM-N would have been a nonstrategic weapon, just like gravity bombs employable by DCA. Unlike forward-deployed DCA, the SLCM-N would not have relied on host-nation basing.

SLCM-N critics might argue that U.S. deterrence effectiveness did not suffer after the TLAM-N's removal from deployment by the 1991 Presidential Nuclear Initiatives or its retirement by the Obama administration's 2010 NPR. Additionally, the problems of messaging and the global perception of this weapon come into play. The United States frames the SLCM-N as being a response to Russian development and deployment of new weapons, so the argument goes that the SLCM-N will not start a new arms race between Russia and the United States. But what if Russia does not see the SLCM-N as an opposite and equal reaction to its own weapons developments? Russian officials have gone on the record saying as much. The United States' pursuit of low-yield, nonstrategic nuclear weapons has been called aggressive, and Russian Foreign Ministry spokesperson Maria Zakharova has said, "One gets the impression that in Washington they have decided to purposefully consider nuclear conflict as a viable political option and create the corresponding potential for this."[16] Russia's stated perception of the U.S. pursuit of low-yield weapons is that the United States is being aggressive, which logically means that Russia could decide to pursue production of more weapons to "balance" the state of affairs between the two countries, leaving the United States facing an even larger Russian stockpile of theater nuclear weapons.

WOULD THE SLCM-N PROVIDE ASSURANCE IN THE PACIFIC?

At the margins, the evidence suggests that the SLCM-N would provide some assurance in the Pacific. Beyond considerations related to Russia, one of TLAM-N's main roles was assurance of U.S. Pacific allies. The 2009 Congressional Commission on the Strategic Posture of the United States found that:

> In Asia, extended deterrence relies heavily on the deployment of nuclear cruise missiles on some Los Angeles class attack submarines—the Tomahawk Land Attack Missile/Nuclear (TLAM/N). This capability will be retired in 2013 unless steps are taken to maintain it. U.S. allies in Asia are not integrated in the same way into nuclear planning [as NATO] and have not been asked to make commitments to delivery systems. In our work as a Commission it has become clear to us that some U.S. allies in Asia would be very concerned by TLAM/N retirement.[17]

13 George H. W. Bush, "Address to the Nation on Reducing United States and Soviet Nuclear Weapons" (speech, September 27, 1991), https://bush41library.tamu.edu/archives/public-papers/3438.

14 U.S. Department of Defense, *Nuclear Posture Review* (Washington, DC: Department of Defense, April 2010), 28, https://dod.defense.gov/Portals/1/features/defenseReviews/NPR/2010_Nuclear_Posture_Review_Report.pdf.

15 For more on the TLAM-N, see Amy Woolf, "Nuclear-Armed Sea-Launched Cruise Missile (SLCM-N)," Congressional Research Service, IF12084, updated December 16, 2022, https://sgp.fas.org/crs/nuke/IF12084.pdf.

16 Tom O'Connor, "Russia Says New U.S. Weapon Makes Nuclear War More Likely – But May Have 2,000 of Its Own," *Newsweek*, March 6, 2020, www.newsweek.com/russia-trump-budget-likely-nuclear-war-1491002.

17 William J. Perry et al., *America's Strategic Posture: The Final Report of the Congressional Commission on the Strategic Posture of the United States* (Washington, DC: United States Institute of Peace Press, 2009), 26, https://www.usip.org/sites/default/files/America's_Strategic_Posture_Auth_Ed.pdf.

When asked in 2009 how he saw SLCMs playing out with Japan, Admiral Timothy J. Keating, then commander of U.S. Indo-Pacific Command (INDOPACOM), responded, "I'm not aware of specific Japanese interest in that particular system that you describe. I am aware, as I say, of Japanese interest in the nuclear umbrella continuing to extend over to Japan."[18] The commander of INDOPACOM would have been aware if there were a real need for the TLAM-N in the Pacific and would surely know if SLCMs were of particular interest to Japanese officials. This directly refutes the 2009 claim made by the Congressional Commission on the Strategic Posture of the United States that the assurance of allies in Asia would be degraded by the TLAM-N's retirement. The 2010 NPR stated that the TLAM-N served a "redundant purpose" in the U.S. nuclear stockpile and that ICBMs and SLBMs can fill the role of the TLAM-N.[19]

Japanese foreign minister Kono Taro released a statement shortly after the release of the 2018 NPR stating that Japan "highly appreciates" that the NPR articulated the U.S. commitment to extended deterrence in light of the worsened international security environment.[20] Any concerns or confusion previously surrounding the TLAM-N and its role in providing assurance in Asia seemed to have dissipated in the wake of the SLCM-N announcement. When it comes to extended deterrence, there is always the chance that a country will choose to not retaliate on behalf of an ally for fear that the aggressor will target their homeland next. During the Cold War, there was always the question about whether the United States would decide to not "sacrifice New York for Brussels." With the SLCM-N, U.S. allies in Asia would likewise have confidence that the United States possesses credible, flexible response options that could hold adversary targets at risk from forward locations without requiring the use of a central strategic system. Even some critics of U.S. nuclear programs note that extended deterrence can be a key pillar of the nonproliferation movement.[21] Given the large-scale Russian invasion of Ukraine and China's military ascendancy and increased arsenal, it is safe to assume that the world is a very different place today than it was at the time of the 2010 NPR. The SLCM-N is needed for assurance in this new environment.

Some critics go even further in arguing that Japan's perceived reliance on the TLAM-N is a result of a public relations campaign by the U.S. defense lobby to protect money-making programs.[22]

The TLAM-N's availability for deployment in the Pacific theater served to assure U.S. allies, namely Japan, of U.S. commitment to their security.[23] This helped dissuade those allies from nuclear proliferation or—arguably more detrimental to the United States—making concessions to U.S. adversaries. The 2018 NPR cited similar logic in justifying SLCM-N development:

> In the 2010 NPR, the United States announced the retirement of its previous nuclear-armed SLCM, which for decades had contributed to deterrence and the assurance of allies, particularly in Asia. Given the increasing need for flexible and low-yield options to strengthen deterrence and assurance, we will immediately begin efforts to restore this capability by initiating a capabilities study leading to an Analysis of Alternatives (AoA) for the rapid development of a modern SLCM.[24]

18 "Admiral Timothy Keating Event Transcript," Atlantic Council, June 29, 2009, www.atlanticcouncil.org/commentary/transcript/keating-timothy-6-29-2009-transcript/.
19 U.S. Department of Defense, *Nuclear Posture Review* (2010), 28.
20 "The Release of the U.S. Nuclear Posture Review (NPR) (Statement by Foreign Minister Taro Kono)," Ministry of Foreign Affairs of Japan, February 3, 2018, https://www.mofa.go.jp/press/release/press4e_001893.html.
21 Hans Kristensen, "Japan, TLAM-N, and Extended Deterrence," Federation of American Scientists, July 2, 2009, fas.org/blogs/security/2009/07/tlam/.
22 Ibid.
23 Ibid.
24 U.S. Department of Defense, *Nuclear Posture Review* (2018), 55.

WOULD THE EXISTING U.S. NUCLEAR ARSENAL RENDER THE SLCM-N REDUNDANT?

In today's strategic environment, the SLCM-N strikes the delicate balance between being capable of hedging against other elements of the U.S. nuclear arsenal and doing so without being rendered useless due to redundancy. Opponents of the SLCM-N claim that it is too similar to the Long-Range Standoff (LRSO) missile to be necessary, but the 2018 NPR claims that the SLCM-N is being added to the arsenal because it will "provide additional diversity in platforms, range, and survivability, and a valuable hedge against future nuclear 'break out' scenarios."[25] The 2018 NPR goes on to say that the SLCM "will not require or rely on host nation support to provide deterrent effect."[26] Forward deployment of bombers carrying the LRSO in order to establish an in-theater deterrent presence would in fact require host nation support, which forms a critical difference between the two systems.

Hedging is an additional benefit of adding the SLCM-N to the U.S. nuclear arsenal. Hedging, when referring to nuclear weapons, represents a risk-mitigation strategy that involves deliberate retention of some redundancy between capabilities of weapons and delivery systems within the nuclear arsenal, such that if a geopolitical, technological, operational, or programmatic challenge arises regarding any aspect to the nuclear arsenal, the United States possesses compensatory options.[27] For example, the SLCM-N could theoretically hedge against an operational problem with some other U.S. nuclear launch platform or delivery system, a technical problem with some other warhead in the U.S. inventory, or a geopolitical problem such as a strategic breakout by an adversary from its existing nuclear weapons production and deployment levels.

The addition of the SLCM-N hedges against challenges involving ballistic missile use. Cruise missiles are slower than ballistic missiles but are more maneuverable in flight. Many cruise missiles, especially subsonic ones, fly very low to avoid detection until just before the endgame. Supersonic and hypersonic cruise missiles, in contrast, tend to fly at higher altitudes and then dive at their targets, using their speed to degrade a defense-in-depth.[28] A surprise major advancement in ballistic missile defense capabilities by an adversary, unforeseen major technical reliability issues involving U.S. ICBMs and SLBMs, or a presidential desire to not use strategic ballistic missile forces based on a situation's circumstances could be reasons why the SLCM-N might provide desired additional flexibility in deterrence or response options.

Critics might note that the U.S. Air Force is pursuing a nuclear-armed LRSO weapon to replace the current air-launched cruise missiles (ALCM). The LRSO is a nuclear-tipped ALCM that will be deployed on B-52 bombers and B-21 stealth bombers.[29] The arguments in favor of the LRSO are similar to the arguments in favor of adding the SLCM-N to the U.S. nuclear arsenal. If the justifications for the two systems are the same, it begs the question as to whether both systems are necessary. Reasonably, one could argue that the LRSO is the appropriate course of action because the bomber leg is highly visible and can be used to demonstrate resolve without actually launching a weapon (thus potentially deterring adversaries before an attack).[30]

25 Ibid., 55.
26 Ibid., 54.
27 Ibid., 37.
28 Andrew Feickert, *Missile Survey: Ballistic and Cruise Missiles of Foreign Countries*, CRS Report No. RL30427/3 (Washington, DC: Congressional Research Service, March 2004), https://crsreports.congress.gov/product/pdf/RL/RL30427/3.
29 John Tirpak, "Cruise Missile Controversy," *Air Force Magazine*, May 29, 2018, www.airforcemag.com/article/cruise-missile-controversy/.
30 Kingston Reif and Travis Sharp, "Pruning the Nuclear Triad? Pros and Cons of Submarines, Bombers, and Missiles," Arms

The U.S. Navy recently deployed the W76-2 low-yield SLBM warhead.[31] The W76-2 partially satisfies the 2018 NPR requirement for supplementary deterrence capabilities, as it is deployed on a central strategic system that does not affect the general-purpose fleet's ability to operate. Some critics might argue that the SLCM-N would have been a suboptimal solution relative to the W76-2, as the former would be deployed in general-purpose fleet combatants and would have degraded the utility of those ships or submarines for nonnuclear operations, such as possible limits on port calls and loss of launcher space that could have otherwise been used to load conventional weapons.

WOULD THE SLCM-N BRING RUSSIA TO THE ARMS CONTROL NEGOTIATION TABLE?

This question warrants further investigation. A major part of the argument in favor of adding the SLCM-N to the U.S. nuclear arsenal is that it will encourage Russia to return to negotiations on arms control after a series of alleged INF violations, including its deployment of a prohibited new land-based cruise missile. But a problem with this argument is that Russia has been allegedly violating arms control agreements since at least the mid-2000s, before the TLAM-N was officially retired in 2013.[32] If Russia has been violating treaties since the TLAM-N was deployed, why should the United States believe that deploying the SLCM-N—the modern iteration of the TLAM-N—will encourage Russia to negotiate?

Another problematic aspect of the desire to use the SLCM-N to convince Russia to revisit discussions on nuclear arms treaties is that the United States is spending billions of dollars on a weapon that will be used as little more than a bargaining chip. Russia perceives U.S. conventional strike capabilities and capacity to be far superior to its own.[33] Russia believes that the United States has enough high-precision cruise missiles, and may build enough hypersonic Conventional Prompt Strike (CPS) weapons in the future, to conduct decapitating and even disarming attacks against it and its critical infrastructure. Russian officials are on record saying that Russia wants to negotiate on hypersonic missiles.[34] As a result, the United States is in a position to put conventional weapons on the table for a negotiation: Russia could advocate for a limit to U.S. conventional long-range precision strike weapons, and the United States could seek a limit on Russia's nonstrategic nuclear weapons, in addition to continuation of traditional strategic nuclear arms control. Therefore, one could argue that the United States does not need to barter using the SLCM-N when the CPS and other conventional systems are enough to bring Russia to the negotiation table.

The Pershing II ground-launched ballistic missile (GLBM) and Gryphon ground-launched cruise missile (GLCM) are often cited as examples proving that the SLCM-N would bring Russia to the

Control Association, May 16, 2013, https://armscontrolcenter.org/pruning-the-nuclear-triad-pros-and-cons-of-submarines-bombers-and-missiles/.

31 "Statement on the Fielding of the W76-2 Low-Yield Submarine Launched Ballistic Missile Warhead," U.S. Department of Defense, February 4, 2020, www.defense.gov/Newsroom/Releases/Release/Article/2073532/statement-on-the-fielding-of-the-w76-2-low-yield-submarine-launched-ballistic-m/.

32 "The truth about Russian violation of INF Treaty," U.S. Embassy in Slovakia, March 28, 2019, https://sk.usembassy.gov/the-truth-about-russian-violation-of-inf-treaty/; and Michael R. Gordon, "Russia Deploys Missile, Violating Treaty and Challenging Trump," *New York Times*, February 14, 2017, www.nytimes.com/2017/02/14/world/europe/russia-cruise-missile-arms-control-treaty.html.

33 Richard Weitz, "Russian Tactical Nuclear Weapons: Current Policies and Future Trends," in *Russian Nuclear Weapons: Past, Present, and Future* (Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2011), www.jstor.org/stable/resrep12072.12.

34 Alexander Marrow, "Russia says it's ready for hypersonic missile talks with U.S.," Reuters, April 14, 2020, www.reuters.com/article/us-usa-russia-arms/russia-says-its-ready-for-hypersonic-missile-talks-with-u-s-idUSKCN21W14C.

negotiation table. However, they are a poor analogue for the SLCM-N. The SLCM-N has more difficulties fitting within the bounds of arms control accountability than the Pershing II GLBM or Gryphon GLCM. The United States avoided bringing the TLAM-N into the Strategic Arms Reduction Treaty I (START I, the predecessor to New START) negotiations for several reasons: it was not a strategic system; the United States had a decisive advantage in both nuclear- and non-nuclear-tipped SLCMs that it wanted to maintain; the Soviets were in economic decline and would not be able to catch up to the United States anyway; and a high-confidence verification method that an SLCM-N is and will remain nonnuclear is more difficult than for GLCMs or ALCMs because SLCM-Ns loaded aboard a ship or submarine would require intrusive inspections beyond U.S. tolerances. The question of how to leverage the SLCM-N into some kind of arms control agreement is unclear.[35]

While it is impossible to know how Russia would have reacted in the long term to the existence of the SLCM-N, history shows that countervailing U.S. capabilities are necessary contributors in efforts to bring Russia to the table for arms control negotiations. It may be very difficult to satisfactorily capture nonstrategic nuclear weapons systems in a high-confidence verification regime that does not undermine U.S. operational security or other interests. However, it may nevertheless be possible to establish, at minimum, a data exchange regime that provides useful transparency regarding nonstrategic nuclear weapons numbers and postures similar to the SLCM-N data exchange confidence-building measure that was established between the United States and the Soviet Union in 1991 as a side agreement to the START I treaty.[36]

To understand SLCM-N's potential role in supporting arms control with Russia, one can look back to the 1980s at how the Perishing II GLBM and Gryphon GLCM were turning points in bringing the Soviets to the table to negotiate the elimination of their SS-20 intermediate range ballistic missiles (IRBMs), recently deployed in Europe, in the INF Treaty.[37] The increased range of the two capabilities relative to previous theater systems and their pinpoint accuracy made Soviet leaders fear vulnerability to decapitating attacks. These fears, combined with Mikhail Gorbachev's ascendance in 1985 and his prioritization of reducing tensions with the West in order to enable revitalization of the Soviet economy, generated Soviet willingness to negotiate a ban on ground-launched IRBMs and cruise missiles with ranges of 500 to 5,500 kilometers as well as their respective launchers.[38] The SLCM-N could function similarly to the Pershing II in this situation and bring the Russians to the table to discuss nonstrategic nuclear weapons. Russia has no desire to limit its theater nuclear capabilities, let alone completely eliminate them, because it is convinced that these weapons are necessary to balance against NATO's conventional force superiority.[39] The incompetence of Russian general purpose forces in the ongoing war in Ukraine likely magnifies this perception in the Kremlin.

35 Robert J. Lempert, *Cruise Missile Arms Control* (Santa Monica, CA: RAND Corporation, 1989), https://www.rand.org/pubs/reports/R3792.html.

36 "Joint Statements Exchanged at the Final Plenary (July 29)," U.S. Department of State Archive, July 29, 1991, https://1997-2001.state.gov/global/arms/starthtm/start/declsts.html.

37 "Treaty Between the United States of America and the Union of Soviet Social Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles (INF Treaty)," U.S. Department of State, December 8, 1987, https://2009-2017.state.gov/t/avc/trty/102360.htm.

38 Ibid.

39 Richard Sokolsky, "The New NATO-Russia Military Balance: Implications for European Security," Carnegie Endowment for International Peace, March 13, 2017, https://carnegieendowment.org/2017/03/13/new-nato-russia-military-balance-implications-for-european-security-pub-68222.

CONCLUSION

Given the answers to each of the central questions above, the SLCM-N, while an imperfect solution to the problems it sets out to solve, represents a necessary asset to the U.S. nuclear arsenal. Thus, the current administration should revisit its decision to cancel the program.

The SLCM-N is not enough to bring about the kind of systematic, large-scale change and disarmament that the United States wants to see in its relationship with Russia, but with time and generational change in Russian leadership, the United States will begin to see progress. Improved diplomatic relations paired with a robust nuclear arsenal and a policy of following through on threats and redlines will be a winning combination for arms control in the short term, and the SLCM-N is a key piece to this equation. In the meantime, the SLCM-N diversifies U.S. deterrence capabilities, thereby helping to disabuse adversaries of destabilizing beliefs they may harbor with respect to their concepts for limited nuclear or nonnuclear strategic attacks.

Tailored Assurance amid the Growing U.S.-Allied Interoperability Gap

By Joshua B. Page[1]

INTRODUCTION

The United States extends a formal nuclear security guarantee to 35 countries—including members of NATO, South Korea, Japan, and Australia—commonly referred to as the U.S. nuclear umbrella.[2] This extended deterrence model has underpinned global nonproliferation efforts since 1954 by obviating the need for U.S. allies to build their own nuclear deterrent, while simultaneously signaling strong U.S. commitment to allied security.[3]

This guarantee originated in the Cold War as a hedge against the only other nuclear power of the day, the Soviet Union. In today's multipolar, highly proliferated world, revisionist powers such as China, Russia, North Korea, and Iran seek to use or develop nuclear weapons as a means of coercing their neighbors and threatening the stability of the U.S.-led, rules-based international order. Russia's 2022 invasion of Ukraine and its continued nuclear saber-rattling have renewed a sense of urgency in the international community to reassess the U.S. extended nuclear deterrent status quo and determine whether its declaratory statements alone are sufficient to deter future aggression. Many U.S. allies are beginning to have doubts. The ability of adversaries to strike the U.S. homeland brings into question what Washington is willing to risk for Seoul, Sydney, Tokyo, or Brussels.

1 Captain Joshua Page currently serves as a USAF B-2 instructor pilot. The views expressed in this paper are those of the author and do not reflect the official policy or position of the Department of the Air Force, the Department of Defense, or the U.S. government.

2 "The Nuclear World: Nuclear Proliferation," Council on Foreign Relations, updated July 27, 2023, https://world101.cfr.org/global-era-issues/nuclear-proliferation/nuclear-world.

3 *NATO,* 2022 NATO Strategic Concept (Brussels: NATO, 2022), https://www.nato.int/nato_static_fl2014/assets/pdf/2022/6/pdf/290622-strategic-concept.pdf.

As the nuclear question is once again under international scrutiny, much thought has been given to the idea of tailored deterrence—the idea that a "one-size-fits-all" approach is ineffective in deterring a wide range of adversaries, including rogue powers, terrorist networks, and near-peer competitors. Similarly, this paper argues that each ally under the U.S. nuclear umbrella requires its own unique approach to nuclear assurance and conventional interoperability given the wide range of security challenges and varying levels of direct U.S. involvement in each country's respective security. If the United States continues to offer the one-size-fits-all declaratory statements of extended deterrence, it risks maintaining a tone-deaf approach that treats all nations under the U.S. umbrella as a monolith.

Two independent forces simultaneously challenge these assurance and interoperability objectives: increasingly aggressive authoritarian powers, and the convergence of multiple disruptive technologies. The purpose of this paper is to analyze the existing U.S.-allied military command structure within NATO, South Korea, Japan, and Australia before arguing that the United States must implement an approach based on tailored assurance—one that presents tangible initiatives and guides the strategic planning of U.S. allies. In doing so, the United States can reinforce global assurance, deterrence, and nuclear nonproliferation efforts while ensuring future interoperability with these allies in a rapidly evolving technical environment that threatens currently fielded conventional forces and the economic industrial bases of U.S. allies.

NATO

NATO was formed in the turbulent aftermath of World War II. As a fractured Western Europe was being rebuilt under the Marshall Plan, the United States and its allies became wary of the existential threat posed by a numerically superior and increasingly aggressive Soviet army. The United States offered allied assurances via the mutual defense clause of Article V of the North Atlantic Treaty, as well as with the implementation of what later became known as the First Offset Strategy, which leveraged the growing U.S. nuclear capability as a hedge against a numerically superior Soviet force.[4]

Effectively managing the fledgling alliance and its nuclear deterrent required a robust and adaptable decisionmaking body for discussing policy, identifying operational challenges, and building consensus.[5] The primary decisionmaking bodies within NATO, both of which are chaired by the NATO secretary general, are the North Atlantic Council (NAC) and the Nuclear Planning Group (NPG). The NAC is the principal political decisionmaking body within NATO and is comprised of the permanent representatives of member nations, while the NPG deals specifically with NATO nuclear policy and requires absolute consensus among members when voting on nuclear issues. The NPG is composed of the defense ministers of all member nations except France.

Subordinate to these councils is the Military Committee, which provides military advice to NATO political leadership and translates political decisions into military orders to be implemented via NATO's two independent strategic commands: Allied Command Transformation (ACT) and Allied Command Operations (ACO). ACT, headquartered in Norfolk, Virginia, is concerned with the administrative tasks of organizing, training, and equipping NATO forces and developing capabilities and doctrine, much like a U.S. major command. The ACO is headquartered in Mons, Belgium, and is known as Supreme Headquarters Allied Powers Europe (SHAPE). SHAPE is charged with planning and

4 Ibid.

5 Jeffrey W. Hornung, *Modeling a Stronger U.S.-Japan Alliance: Assessing U.S. Alliance Structures* (Washington, DC: CSIS, November 2015), https://csis-website-prod.s3.amazonaws.com/s3fs-public/151109_Hornung_Alliance_Models_4.pdf.

executing NATO military operations and functions, much like a U.S. combatant command. SHAPE is commanded by the supreme allied commander, Europe (SACEUR)—traditionally a four-star U.S. officer who is also "dual-hatted" as commander of U.S. European Command (EUCOM). Under the SACEUR are two joint force commands (JFCs), in Italy and the Netherlands, which consist of single-service commands that provide domain-specific (i.e., air, land, or naval) expertise to the JFCs.[6]

Among the growing list of NATO members, there are to date only three nuclear weapon states: the United States, France, and the United Kingdom. Only the United States explicitly extends its own nuclear weapons as a collective security guarantee, and it is the official policy of NATO that "the strategic nuclear forces of the Alliance, particularly those of the United States, are the supreme guarantee of the security of the Alliance."[7]

Perhaps the surest sign of this U.S. guarantee is the concept of "nuclear sharing." Nuclear sharing is the process by which the United States, with NATO host-nation approval, permanently stations B61 gravity nuclear bombs in select locations throughout Europe. Day-to-day, these weapons remain under U.S. custody and control, but during times of war and with absolute NPG consensus and U.S. presidential approval, U.S. personnel will transfer custody of the weapons to the host nation by mating U.S. nuclear weapons to allied aircraft that are certified for nuclear operations under the Dual Capable Aircraft (DCA) program.[8] Current DCA roles are filled by Belgium, Germany, Italy, Turkey, and the Netherlands, using primarily fourth-generation F-16 and Tornado aircraft, with many allies planning to replace these aging systems with the fifth-generation F-35 stealth fighter.

While these efforts inspire political cooperation and alliance cohesion, they are also sometimes a source of contention. As most Europeans are members of nonnuclear-weapon states, there is a paradoxical relationship between their views regarding the morality of nuclear weapons and the vital role they play in the broader security dynamics of the NATO alliance. In this context, recurring contentious political debates among European domestic audiences regarding the needed or wanted presence of U.S. nuclear weapons threaten to undermine the long-term credibility and resolve that the nuclear-sharing arrangement is meant to communicate to would-be aggressors. The Russian invasion of Ukraine has generally revitalized European public support for the U.S. extended deterrent, while critics point out that bases that host forward-deployed U.S. nuclear weapons and the aircraft that carry them would make an attractive first-strike target for a Russian tactical nuclear weapon.

Assuming that nuclear sharing endures, and NPG consensus is reached, NATO's most likely use of the DCA concept would be in an attempt to deter via posturing and message or to de-escalate via counterstrike. However, the processes for activating these capabilities may be too slow and cumbersome to coordinate and effectively employ under the existing ACO construct. According to a Government Accountability Office report, certain NATO allies must maintain the ability to be on alert for nuclear operations within a 30-, 180-, or 365-day period of notification.[9] Even if these are conservative estimates to generate a tactical nuclear strike sortie, this time-constrained option poses neither a realistic nor credible deterrent in any real sense.

6 Ibid.
7 NATO, *2022 NATO Strategic Concept*.
8 Matthew P. Anderson, "NATO Nuclear Deterrence: The Warsaw Sumit and Beyond," *Connections Quarterly Journal* 15, no. 4 (2016): 5–30, https://doi.org/10.11610/Connections.15.4.01.
9 Hornung, *Modeling a Stronger U.S.-Japan Alliance*.

Even given a timely response and perfect execution at every stage, NATO planners must assume the risk that any NATO B61 nuclear response would be tactical in scale and, while significant, does not offer critical rungs on the "escalation ladder" that would be likely to deter or de-escalate imminent or ongoing strategic attacks by a nuclear adversary.

The United States comprises over a third of the conventional military force of the NATO alliance, and only the strategic nuclear forces of the United States offer a credible, visible, recallable, and proportional response to ensure NATO's enduring security across all spectrums of conflict; in short, NATO still very much needs the United States.[10]

Rather than have 35 different approaches to each member state of NATO, U.S. tailored assurance efforts should focus on strengthening alliance institutions and optimizing the processes that govern long-established formal coordination and decisionmaking mechanisms.

SOUTH KOREA

In 1950, North Korea invaded the newly independent South Korea with the goal of reunifying the peninsula under communist rule. The United Nations, intent on preventing another global catastrophe only five years after the end of World War II, passed Security Council Resolutions 83 and 84, which authorized UN forces to restore peace on the Korean Peninsula. The United States was chosen to head the newly formed United Nations Command (UNC) and was responsible for leading a joint force of U.S. and allied troops under the UN banner.[11]

Reaching a stalemate after three years of conflict, North and South Korea signed the Armistice Agreement in 1953, which brought an end to all military actions. The Military Armistice Committee (MAC), a subcommittee of the UNC, has been responsible for enforcing the terms of the armistice ever since. Soon after the armistice was signed, the United States and South Korea signed the bilateral U.S.-ROK Mutual Defense Treaty, which served as the legal basis for granting the United States operational control (OPCON) over a UN multinational force tasked with protecting South Korea's sovereignty.[12] To deter further North Korean aggression and, to a lesser extent, Chinese or Soviet expansionism, the U.S. military deployed various short-range "tactical" nuclear weapons in South Korea from 1958 to 1991. Unlike NATO, the United States did not "share" its weapons with South Korea. There was no mechanism akin to the NPG of NATO, and South Korea did not retain veto power.

In 1978, the two nations established the Combined Forces Command (CFC).[13] Under the CFC construct, South Korean security decisions were made bilaterally through highly intertwined staffing and planning processes, providing a high degree of transparency and fostering mutual trust. Supporting both the CFC and UNC multinational forces is United States Forces, Korea (USFK). The USFK's primary role is to organize, train, and equip forces assigned to the defense of South Korea by maintaining readiness through joint training and support operations. To maintain unity of command and span of control, one U.S. four-star general officer is traditionally "triple-hatted" as the commander of the UNC, USFK, and CFC.[14]

10 Ibid.
11 Hornung, *Modeling a Stronger U.S.-Japan Alliance*.
12 Chad Nishizuka, "Demistifying the U.S.-ROK Command and Control Structure: How 'OPCON Transfer' Can Advance the Unity of Effort on the Korean Peninsula," U.S. Naval War College, May 4, 2018, https://apps.dtic.mil/sti/citations/AD1062063.
13 Ibid.
14 "Combined Forces Command," United States Forces Korea, n.d., https://www.usfk.mil/About/CFC/.

After the fall of the Soviet Union in the 1990s, the United States removed all nuclear weapons from the peninsula and transferred peacetime OPCON of South Korean conventional forces to the South Korean joint chief of staff (JCS). This transition, while well intentioned, confused lines of authority and split the commander's responsibilities during peacetime and hostilities. For instance, the JCS is responsible for deterring external aggression and conducting the initial defense of South Korea during the opening stages of a crisis, while the CFC commander, an American, assumes OPCON of combined U.S.-ROK forces and defends South Korea during ongoing hostilities. This transition happens somewhere between crisis and hostility, making it somewhat subjective, and has the potential to stress alliance relations at a time when maintaining cohesion is critical.[15] This command and control structure, still in force today, essentially creates two parallel chains of command, with many overlapping and sometimes competing requirements and responsibilities.[16]

The division of OPCON into peacetime and wartime is not intended to be permanent. South Korea is a highly developed democracy and a regional economic powerhouse, and yet it does not maintain full-time authority over its military. Despite several attempts to transfer wartime OPCON to South Korea, each attempt has been canceled due to North Korean threats or South Korea's lack of military and logistical readiness to assume command. South Korea's proximity to increasingly aggressive nuclear-armed adversaries continues to necessitate a high level of direct U.S. involvement in South Korean security, delaying, perhaps indefinitely, the realization of an entirely independent South Korean military. Within this context, South Korea is the most dependent state under the U.S. extended deterrent concept, and thereby the most likely to need a more direct and explicit tailored assurance approach.

JAPAN

Article 9 of the constitution of Japan renounces war as a sovereign right of the nation and prohibits Japan from maintaining military forces to settle international disputes.[17] Japan is allowed to maintain armed forces for self-defense purposes only, hence Japan's limited military force, the Japan Self-Defense Forces (JSDF). To ensure Japanese sovereignty in the face of Soviet expansionism, the United States and Japan signed the Treaty of Mutual Cooperation and Security in 1951, which provides the legal basis for the ongoing U.S. military presence in Japan.[18]

North Korea's history of destabilizing rhetoric and provocative actions, coupled with China's more recent encroachments on the Senkaku Islands, among other violations, have caused many in Japan to consider whether its constitutional provisions should be revised or even abolished. In 2015, under Prime Minister Abe Shinzo, Japan reinterpreted its constitution, enabling its military to defend allies for the first time—albeit under restricted circumstances.[19]

With this backdrop in mind, the U.S.-Japanese command and control structure consists of two main elements: bilateral diplomatic coordination and U.S. Indo-Pacific Command (INDOPACOM). Under INDOPACOM is U.S. Forces Japan (USFJ), headquartered at Yokota Air Base, Tokyo, and commanded by a four-star U.S. general officer who is responsible for the day-to-day operations of U.S. military forces and who works closely with the JSDF chief of staff.

15 Nishizuka, "Demistifying the U.S.-ROK Command and Control Structure."
16 Ibid.
17 Rieko Miki, "Japan to establish Self-Defense Forces 'joint command' in 2024," Nikkei Asia, October 29, 2022, https://asia.nikkei.com/Politics/Japan-to-establish-Self-Defense-Forces-joint-command-in-2024.
18 "Treaty of Mutual Cooperation and Security between Japan and the United States of America," Ministry of Foreign Affairs of Japan, n.d., https://www.mofa.go.jp/region/n-america/us/q&a/ref/1.html.
19 Lindsay Maizland and Nathanael Cheng, "The US-Japan Security Alliance," Council on Foreign Relations, updated November 4, 2021, https://www.cfr.org/backgrounder/us-japan-security-alliance.

Bilateral coordination refers to the ongoing consultations between the U.S. and Japanese secretaries of defense and state, known as the U.S.-Japan Security Consultative Committee (SCC), commonly referred to as the "2+2 meeting." However, this current structure is undergoing significant change. In a joint statement of the 2023 U.S.-Japan SCC, the defense ministers announced the establishment of a permanent joint U.S.-Japanese headquarters committed to exploring more effective alliance command and control relationships, with enhanced interoperability and responsiveness at the fore.[20] This initiative has received bipartisan U.S. congressional support via section 1087 of the 2023 National Defense Authorization Act, which requires "the establishment of a Joint Force Headquarters in the Indo-Pacific to integrate joint domain command and control in a conflict that arises with minimal warning."[21]

The Japanese Ministry of Defense, for its part, has self-reformed by establishing a new JSDF command position. Disasters such as tsunamis, earthquakes, and nuclear reactor meltdowns have highlighted the need for such reforms within the ministry.[22] In addition to force structure reform, the Japanese government has vowed to raise its defense spending to 2 percent of GDP by 2027, which equates to a 60 percent increase over current spending levels—which would give Japan the third-largest defense budget in the world.[23] Japan's conventional modernization efforts are being pursued in close coordination with the United States and focus on key mission areas such as integrated air and missile defense; anti-surface warfare; anti-submarine warfare; mine warfare; amphibious and airborne operations; intelligence, surveillance, and reconnaissance; targeting; logistics; and mobility.[24]

Japan is making great strides in military modernization and readiness, but the demographic and economic challenges facing the country may pose a significant obstacle to sustained long-term military investment. Japan has one of the lowest birth rates in the developed world, which exacerbates its already aging workforce and worsens the looming skill and labor shortage.[25] The JSDF continues to be plagued by its decades of insufficient spending, including outdated physical infrastructure, antiquated equipment, low stocks of munitions, a lagging industrial base, and inadequate airlift, sealift, and refueling capabilities. The process of procuring new weapons and equipment, enhancing infrastructure, and revitalizing Japan's defense sector will require significant time, funding, and political will and is unlikely to deliver tangible benefits until well after 2027.[26]

Japan's tailored assurance needs are likely somewhere in between that of NATO and South Korea. Japan and the United States share formal defense ties and ever-strengthening collaboration and decisionmaking mechanisms, though these are not as mature or robust as those of NATO. While Japan maintains full OPCON over its military forces, domestic political limitations and external security pressures force Japan to continue to rely heavily on the United States for its defense.

20 "Japan-U.S. Security Consultative Committee (Japan-U.S. '2+2')," Ministry of Foreign Affairs of Japan, January 11, 2023, https://www.mofa.go.jp/na/st/page4e_001338.html.
21 Zack Cooper and Allison Schwartz, "Five Notable Items for Asia Watchers in the National Defense Authorization Act," American Enterprise Institute, December 16, 2022, https://www.aei.org/foreign-and-defense-policy/five-notable-items-for-asia-watchers-in-the-national-defense-authorization-act/.
22 Miki, "Japan to establish Self-Defense Forces 'joint command' in 2024."
23 Jennifer Kavanagh, "Japan's New Defense Budget Is Still Not Enough," Carnegie Endowment for International Peace, February 8, 2023, https://carnegieendowment.org/2023/02/08/japan-s-new-defense-budget-is-still-not-enough-pub-88981.
24 Stacie Pettyjohn and Becca Wasser, *No I in Team: Integrated Deterrence with Allies and Partners* (Washington, DC: Center for a New American Security, December 2022), https://www.cnas.org/publications/reports/no-i-in-team.
25 Ibid.
26 Ibid.

AUSTRALIA

The 1951 Australia, New Zealand, United States (ANZUS) Treaty is a mutual defense security alliance between Australia, New Zealand, and the United States. New Zealand withdrew from the treaty's defense provisions in 1985, citing its opposition to U.S. nuclear policies.

Unlike the NATO, South Korean, or Japanese models, the U.S.-Australian alliance does not share an integrated command structure or a permanent U.S. military presence.[27] Instead, the alliance focuses on collaboration and cooperation rather than direct or shared OPCON of forces. The most enduring examples of this collaborative relationship are the Australia-U.S. Joint Defense Facility Pine Gap, a satellite tracking station and signals intelligence facility located in the Northern Territory of Australia, and the Jindalee Operational Radar Network (JORN) over-the-horizon radar.[28] These facilities play a critical role in U.S.-Australian intelligence-gathering and operations-support efforts in the Asia-Pacific region. The United States and Australia have collaborated on several other joint ventures, including the Combined Forces Air Component Command in Queensland and the Joint Combined Training Capability in South Australia.[29] The United States also maintains a robust, yet impermanent, military presence in Australia through efforts such as the Marine Rotational Force-Darwin and by conducting strategic Bomber Task Force missions, whereby U.S. bombers are flown and operated out of Royal Australian Air Force bases and integrate regularly with their Australian counterparts. Moreover, both countries have hundreds of exchange officers, creating a wide-ranging network of relationships and fostering intra-alliance trust.

Recently, the most visible outgrowth of this trust has been on display in the AUKUS trilateral security partnership, a new agreement between Australia, the United Kingdom, and the United States to build nuclear-powered, conventionally armed submarines for the Royal Australian Navy. The announcement marks a significant shift in Australia's defense strategy amid China's growing military assertiveness in the region. One of the most noteworthy aspects of the AUKUS submarine agreement is the transfer of sensitive technology regarding nuclear component design, development, and propulsion, which underscores the level of trust and cooperation between the three countries. This critical information will provide a massive leap forward in the Australian navy's conventionally armed submarine fleet, enhancing regional deterrence and bolstering Indo-Pacific security.[30]

Australia's military self-reliance is largely an outgrowth of its geography. As a continent-sized nation far-flung from its adversaries, and whose domestic security has been largely unchallenged since World War II, it can enjoy a friendly yet non-reliant relationship with the United States. However, this security environment has begun to shift; China's increasingly aggressive and destabilizing behavior has drawn into focus how contested Australia's national interests are and has spurred more active cooperation with the United States and other like-minded partners. The U.S. tailored assurance approach to Australia should capitalize on the momentum this sense of urgency provides and seek to build a shared strategic concept that empowers Australian regional influence as the largest and strongest democracy in the Indo-Pacific.

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27 Hornung, *Modeling a Stronger U.S.-Japan Alliance*.

28 Anna Hood and Monique Cormier, "The Role of ANZUS in Australia's Reliance on US Extended Nuclear Deterrence," Australian Institute of International Affairs, September 16, 2021, https://www.internationalaffairs.org.au/australianoutlook/the-role-of-anzus-in-australias-reliance-on-us-extended-nuclear-deterrence/.

29 Martin Dufour, "Will AI challenge NATO Interoperability?," NATO Defense College, NDC Policy Brief, no. 6, December 2018, https://www.jstor.org/stable/resrep19838.

30 "Statement by Secretary of Defense Lloyd J. Austin III on AUKUS Optimal Pathway Announcement," U.S. Department of Defense, March 13, 2023, https://www.defense.gov/News/Releases/Release/Article/3327747/statement-by-secretary-of-defense-lloyd-j-austin-iii-on-aukus-optimal-pathway-a/.

WHY TAILORED ASSURANCE?

The extent of U.S. involvement in an ally's security is directly proportional to the level of vulnerability perceived by that ally. In the case of NATO, the Soviet Union and, today, the Russian Federation have posed such an existential threat to European security that ironclad Article V mutual defense provisions and the presence of U.S. nuclear weapons on European soil remain to this day. South Korea, despite being a highly developed major global economic power, continues to share custody of its military with the United States as a necessary hedge against North Korean and Chinese aggression. Japan, despite its pacifist constitution and wholly separate JSDF chain of command, has drawn closer to the United States, established a first-ever joint U.S.-Japanese command, made unprecedented commitments to its defense budget, reinterpreted its constitution, and made explicit requests for the United States to reiterate its nuclear deterrent commitments despite Japan's sensitive relationship with nuclear weapons. Australia, which enjoys perhaps the most laissez-faire relationship under the U.S. umbrella, has made extraordinary defense commitments and has become a more active partner in shouldering the regional defense and deterrence burden.

The United States' 2022 National Defense Strategy advocates for "integrated deterrence" by integrating all tools of national power across all domains of conflict to deter adversaries while working with allies and partners. What exactly that means in practical terms remains unclear, and this ambiguity risks alienating critical allies and partners at precisely the wrong moment.[31]

The United States' strong network of alliances is, and will continue to be, an enduring strategic advantage, and as the above analysis illustrates, the allies that the United States strives to assure are just as unique and complex as the adversaries it seeks to deter. When the United States neglects to proactively tailor its assurance efforts, it risks undermining the credibility of those alliances and is compelled instead to engage in reactive diplomacy, addressing one internal crisis after the other. A timely example highlighting the need for tailored assurance is the April 2023 Washington Declaration, a joint statement between the U.S. and South Korean heads of state following a string of North Korean missile tests. The Washington Declaration highlights the costs of reactive versus proactive assurance, and while the details pertain to the U.S.-South Korea alliance specifically, the lessons learned can be applied to the U.S.-allied network more broadly.

In January 2023, amid continued North Korean nuclear testing and mounting regional tensions, President Yoon Suk Yeol stated publicly that South Korea would consider building nuclear weapons of its own or asking the United States to redeploy its nuclear weapons to the Korean Peninsula.[32] President Yoon's comments understandably caused significant nonproliferation concerns among the international community and left Washington scrambling to respond.

The Biden administration, forced to clarify its position and that of the bilateral alliance, released a joint statement with President Yoon, who publicly "walked back" his divisive comments, which later became known as the Washington Declaration.[33] This joint statement, a form of reactive diplomacy, sought to accomplish four things: reassert both countries' commitment to the Nuclear Non-Proliferation Treaty, project strength and unity in the U.S.-South Korea relationship, reiterate a strong

31 Pettyjohn and Wasser, *No I in Team*.

32 Choe Sang-Hun, "In a First, South Korea Declares Nuclear Weapons a Policy Option," *New York Times*, January 12, 2023, https://www.nytimes.com/2023/01/12/world/asia/south-korea-nuclear-weapons.html.

33 Scott A. Snyder, "The Washington Declaration: Expanding the Nuclear Dimension of the U.S.-South Korean Alliance Response," Council on Foreign Relations, April 27, 2023, https://www.cfr.org/blog/washington-declaration-expanding-nuclear-dimension-us-south-korean-alliance-response.

deterrence posture against North Korea without further raising regional tensions, and provide South Korea with new, more tangible assurances of U.S. commitment.

While President Yoon was forced to retract his remarks, which seem to have cost him at least some political capital with the United States, it is hard to argue that the comments did not work. Seoul received assurances, including

1. the U.S.–ROK Nuclear Consultative Group (NCG), a regular bilateral consultation mechanism focusing on nuclear and strategic planning issues;
2. increased visibility of U.S. strategic assets to the peninsula;
3. increased integration of South Korean conventional forces in support of U.S. nuclear operations, exercises, and planning;
4. enhanced information-sharing and decisionmaking cooperation on nuclear deterrence; and
5. inclusion in tabletop wargaming exercises with U.S. Strategic Command.

This sets a potentially dangerous precedent. If a U.S. ally feels that their security needs are not being properly addressed, a provocative public statement that is sure to snag headlines will force the United States to act. Even if that ally only gets some of what they want, and undermines alliance credibility in the process, it is better than the status quo where they feel ignored.

INTEROPERABILITY AND EMERGING TECHNOLOGY

How the United States chooses to tailor this nuclear assurance message may depend upon the existing command relationship and the degree of conventional interoperability U.S. and allied forces share. As previously discussed, the defense sectors of many allies continue to lag behind those of U.S. adversaries, placing an increasingly heavy conventional and nuclear deterrent burden upon the United States. As the world navigates the Fourth Industrial Revolution, characterized by artificial intelligence (AI), quantum computing, and machine learning technologies, the U.S.-allied interoperability gap continues to widen, threatening the relevance of the twentieth-century alliance network while simultaneously offering an opportunity to reimagine what this dynamic could or should look like.[34]

Today's current and emerging military technologies require extraordinary investments in sophisticated infrastructure, costly equipment, cutting-edge technology, and a highly skilled workforce, all of which present significant barriers to entry for countries already struggling to meet their current defense needs. Meanwhile, if the United States seeks to stay one step ahead of, or even just to keep pace with, China in these key technologies, U.S. allies will remain miles behind.

For instance, the U.S. Department of Defense appropriated $3.6 billion to invest in leading-edge technologies in FY 2017. While this sum represented only 5 percent of the overall U.S. military research and development (R&D) budget, it was more than 40 percent of the overall EU and European R&D budgets combined.[35] In the years since, technology, and its cost, have advanced exponentially. The FY 2024 U.S. R&D budget will total $210 billion. To contextualize, that is the equivalent of spending the entire GDP of Portugal on R&D alone.

34 Dufour, "Will AI Challenge NATO Interoperability?"
35 Ibid.

The 2018 strikes on Syrian chemical weapons facilities personified this ever-expanding interoperability gap. When the global community needed to respond to the Assad regime's use of chemical weapons, only three countries—the United States, United Kingdom, and France (also the only NATO nuclear member states)—possessed the required precision standoff missiles capable of reaching targets deep inside Syria without putting aircraft or aircrew at unacceptable risk. A similar capability gap exists and is worsening in key capabilities including information sharing, command and control, and battle management. As interconnected systems become the norm in the sensor-saturated modern battlespace, allies who cannot rapidly access or securely share intelligence are unlikely to be included, especially as machine learning and AI revolutionize how that data is processed.[36]

In practice, the future of interoperability should involve the United States encouraging its smaller allies to specialize in critical niche areas, allowing them to focus scarce resources on unique capabilities that could complement the strengths of the broader alliance network. The emerging technologies of the Fourth Industrial Revolution offer a unique opportunity for such specialization, in that almost all of these technologies are software-based and are constantly being developed in concert with the private sector.[37] It is much more cost effective to produce an AI algorithm or software code that can be replicated and easily shared with multiple users for multiple purposes than it is to produce expensive, single-function, single-purpose hardware such as a main battle tank.

The United States, which has the resources to research, design, and manufacture these expensive advanced technologies, should lower the barrier to entry in these fields by providing a "seed investment" of sorts by sharing relevant technology and industrial know-how with trusted partners. These lines of effort, much like the technology transfer of the AUKUS submarine agreement, would do more to bolster combined conventional deterrence than a one-off sale of the newest fighter aircraft. Giving smaller partner nations the tools to meaningfully contribute to their own defense by collaborating on critical technology development would also benefit the domestic economic and defense sectors of those countries. It is not difficult to imagine this sort of future, as regional powers have demonstrated the benefits of niche specialization in the past. For instance, Taiwan produces over 60 percent of the world's semiconductors and over 90 percent of the most advanced chips.[38] Meanwhile, Israel's high-tech economy overperforms given its relatively small size, specializing in information technology solutions and cutting-edge software, which account for over 50 percent of its total national exports.[39] In each of the above examples, these dual-use technologies, developed in cooperation with the private sector, academia, and defense agencies, have benefited not only their host countries but the world.

CONCLUSION

In his first congressional address, President George Washington noted that "to be prepared for war is one of the most effectual means of preserving peace." It is a truth that still resonates today. By analyzing an ally's level of real or perceived threat, and identifying to what extent that ally

36 "Taiwan's dominance of the chip industry makes it more important," *The Economist*, March 6, 2023, https://www.economist.com/special-report/2023/03/06/taiwans-dominance-of-the-chip-industry-makes-it-more-important.
37 Yuna Huh Wong, "Approaching Future Offsets," RAND Corporation, December 21, 2016, https://www.rand.org/pubs/commentary/2016/12/approaching-future-offsets.html.
38 "Taiwan's dominance of the chip industry makes it more important," *The Economist*.
39 Michał Wojnarowicz, "Israel's High-Tech Economy," Polish Institute for International Affairs, November 5, 2022, https://pism.pl/publications/israels-high-tech-economy.

depends directly upon the United States for its security, the United States can prioritize how best to allocate its instruments of national power, employ tailored nuclear assurance, build a cohesive conventional interoperability strategy, and achieve its political objectives of deterrence, assurance, and nuclear nonproliferation.

Adapting the Prisoner's Dilemma for Modern Nuclear Decisionmaking

By Michael D. Walker[1]

The historical approach to nuclear deterrence was singularly focused on mutually assured destruction. The United States and Russia built large, reliable, and secure stockpiles of strategic weapons systems to wipe each other out. Today, this paradigm has largely broken down, and escalation dynamics are far more complex.[2] Russia has built a stockpile of low-yield weapons and novel delivery systems, while the United States has relied more on nonnuclear means of deterrence through strong alliances, conventional military strength, precision weapons, cyber threats, and economic and financial tools.[3] While continually underpinned by the nuclear triad, there are opportunities to fine-tune deterrence through decisions that are precise and proportional. Not only are there more rungs on the Kahnian escalation ladder, but within each rung there are a greater variety of responses. Generally, the departure from mutually assured destruction is viewed as favorable—a move from threatening the use of world-ending weapons to threatening the use of smaller ones or even nonnuclear weapons and tools.[4] However, the effects on escalation itself are less clear. What are the effects of a "pick-your-poison" approach to deterrence on stable decisionmaking and conflict termination? This paper proposes a model of a non-binary deterrence decision matrix by designing a cooperative game, based on the stochastic iterated prisoner's dilemma,

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2 Joseph S. Nye, Jr., "Dilemmas of Deterrence," Project Syndicate, May 2, 2023, https://www.project-syndicate.org/commentary/american-dilemmas-of-deterrence-in-north-korea-taiwan-strait-by-joseph-s-nye-2023-05.

3 U.S. Department of Defense, *Nuclear Posture Review* (Washington, DC: U.S. Department of Defense, 2022), https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.PDF.

4 Paul K. Kerr, "Defense Primer: Strategic Nuclear Forces," Congressional Research Service, IF10519, updated May 19, https://sgp.fas.org/crs/natsec/IF10519.pdf.

that incorporates varying levels of cooperation and defection.[5] This new game closely simulates the real-world choices required of rational agents when integrated deterrence presents many options for response. The effectiveness of various strategies is shown, with stable and historically consistent results to achieve de-escalation and conflict termination.

WONDER WEAPONS AND INTEGRATED DETERRENCE: IMPROVING PRECISION

Russia has built a series of novel nuclear delivery systems ostensibly designed to evade the United States' defenses and deterrence posture.[6] These weapons include the SSC-X-9 Skyfall, a nuclear-powered nuclear-armed cruise missile; Killjoy, a conventional air-launched hypersonic cruise missile; Poseidon, an autonomous, nuclear-powered, nuclear-armed unmanned underwater vehicle; Vanguard, a nuclear-armed hypersonic boost-glide vehicle; and the RS-28 Sarmat, a next-generation intercontinental ballistic missile.[7] In a broad and fundamental sense, these weapons change the nuclear paradigm by using speed (increased maneuverability and reduced response time) or endurance (increased stealth and near-unlimited range) to overwhelm existing sensors and defenses.[8] Further, Russia has bolstered an arsenal of lower-yield "tactical" nuclear weapons in a strategy labeled "escalate to de-escalate."[9]

Meanwhile, in the *2022 Nuclear Posture Review*, the United States has stepped away from brinkmanship to emphasize a strategy of "integrated deterrence"—using all instruments of national power and its network of partnerships to deter aggression.[10] This includes building overwhelming superiority in conventional (nonnuclear) military power and leveraging economic influence.[11] Through innovation in missile defense and effective theater anti-submarine warfare, it has demonstrated the ability to hold the Russian arsenal at risk.

Combined, these new approaches to nuclear use in the United States and Russia result in decision pathways that grow exponentially. There are few methods currently developed to model such a complex decisionmaking environment. As will be shown, historical decision modeling, by design, has been "choice-limited." While wargaming might provide deeper granularity in decision scenarios, it loses the generality that motivates the decisions of any rational agent. Noncooperative game theory can provide such a foundation.

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5 For relevant software repositories, please visit https://github.com/yinengy/Mersenne-Twister-in-Python (Mersenne Twister algorithm); https://github.com/Axelrod-Python/Axelrod/tree/dev/axelrod (Axelrod IPD tournament); https://github.com/keyskey/SPDpy (Spatial Prisoner's Dilemma); https://github.com/indrag49/Quantum-Game-Theory (Quantum Game Theory); and http://ccl.northwestern.edu/netlogo/models/PrisonersDilemmaHubNet (Multi-agent modeling).

6 Mark Melamed, Lynn Rusten, and Jill Hruby, *Russia's New Nuclear Weapon Delivery Systems: An Open-Source Technical Review* (Washington, DC: Nuclear Threat Initiative, November 2019), https://media.nti.org/documents/NTI-Hruby_FINAL.pdf.

7 Joshua M. M. Portzer, "Kanyon's Reach: Rethinking the Nuclear Triad in the Autonomous Age," U.S. Naval Institute, *Proceedings* 146, no. 7 (July 2020), https://www.usni.org/magazines/proceedings/2020/july/kanyons-reach-rethinking-nuclear-triad-autonomous-age.

8 Kelley M. Sayler, "Hypersonic Missile Defense: Issues for Congress," Congressional Research Service, IF 11623, updated August 21, 2023, https://sgp.fas.org/crs/weapons/IF11623.pdf; and Mark Melamed and Lynn Rusten, "Russia's New Nuclear Weapon Delivery Systems: Implications for New START, Future Arms Control, and Strategic Stability," Nuclear Threat Initiative, November 2019, https://media.nti.org/documents/NTI-Melamed-Rusten_FINAL.pdf.

9 Daniel Post, "The Value and Limits of Nuclear Deterrence," U.S. Naval Institute, *Proceedings* 149, no. 1 (January 2023), https://www.usni.org/magazines/proceedings/2023/january/value-and-limits-nuclear-deterrence.

10 U.S. Department of Defense, *Nuclear Posture Review*.

11 Congressional Budget Office, *U.S. Hypersonic Weapons and Alternatives* (Washington, DC: Congressional Budget Office, January 2023), www.cbo.gov/publication/58255.

TWO-PLAYER NONCOOPERATIVE GAMES

Game theoretic models of deterrence grossly simplify the complicated reality of decisionmaking with limited knowledge.[12] The simplest (and therein most stable) models are two-person games with both players only having two options for choice. Many advancements have been made to overcome those limitations, including frameworks to support more than two options for each player and more than two players. Additionally, iterated games (also called "repeated games") were developed to analyze series of decisions that are not "one shot"; they overcome the first objection, as mentioned above. Knowing that a game will continue indefinitely will impact how players choose their strategies because players have knowledge of the past behavior of their rivals (they observe their choices).

While not well suited to model nuclear use, the prisoner's dilemma can reproduce the basic motivations and decision dynamics of negotiation, weapons development, and arms control. The U.S.-Soviet arms race, for instance, has commonly been modeled as an iterated prisoner's dilemma (IPD).[13] This led to the surprisingly dominant tit-for-tat strategy that consists of choosing "cooperate" during the first iteration and then copying what the other player did in the previous round, thereby rewarding cooperative behavior and punishing otherwise.[14] This decision rule performed well in many comparisons of strategies for IPD because of its properties of niceness, forgiveness, and "retaliatoriness."[15]

CLASSIC ITERATED PRISONER'S DILEMMA

The prisoner's dilemma is perhaps the best-known game of strategy in social science, modeling the balance of cooperation and competition in multiparty decisionmaking. It is a thought experiment that challenges two rational agents to a dilemma: they can cooperate with their partner for mutual benefit or betray their partner ("defect") for a greater individual reward.[16] If both defect, no reward is earned. They cannot communicate *a priori*. The structure of the prisoner's dilemma can be generalized from its original prisoner setting. Suppose that each player chooses to either cooperate "*C*" or defect "*D*." If both players cooperate, they both receive the reward "*R*" for cooperating. If both players defect, they both receive the punishment payoff "*P*." If Player 1 defects while Player 2 cooperates, then Player 1 receives the temptation payoff "*T*," while Player 2 receives the "sucker's" payoff, "*S*." The transverse is also true. This is shown in Figure 1(a).

The payoff values must hold for a prisoner's dilemma game: $T > R > P > S$ and $2R > T + S$. The payoff relationship $R > P$ implies that mutual cooperation is superior to mutual defection, while the payoff relationships $T > R$ and $P > S$ imply that defection is the dominant strategy for both agents in a singular game.[17] For a singular game, *D* is the dominant strategy for each player and (*D,D*) is the unique Nash equilibrium—the stable state of the system in which no participant can gain

12 John Nash, "Non-cooperative Games," *Annals of Mathematics* 54, no. 2 (September 1951): 286–295, https://doi.org/10.2307/1969529; and Roy Lindelauf, "Nuclear Deterrence in the Algorithmic Age: Game Theory Revisited," in *NL ARMS Netherlands Annual Review of Military Studies 2020: Deterrence in the 21st Century—Insights from Theory and Practice*, Frans Osinga and Tim Sweijs, eds. (The Hague: T.M.C. Asser Press, December 2020), https://doi.org/10.1007/978-94-6265-419-8_22.

13 Stephen Majeski, "Arms races as iterated prisoner's dilemma games," *Mathematical Social Sciences* 7, no. 3 (June 1984): 253–266, https://doi.org/10.1016/0165-4896(84)90022-2.

14 Anatol Rapoport, "Prisoner's Dilemma," in *The New Palgrave Dictionary of Economics* (London: Palgrave Macmillan, 1986), https://doi.org/10.1057/978-1-349-95121-5_1850-1.

15 Robert Axelrod, "Effective Choice in the Prisoner's Dilemma," *Journal of Conflict Resolution* 24, no. 1 (March 1980): 3–25, https://www.jstor.org/stable/173932.

16 William Poundstone, *Prisoner's Dilemma* (New York: Anchor Books, 1993).

17 Leigh Tesfatsion, "Notes on Axelrod's Iterated Prisoner's Dilemma (IPD) Tournaments," Iowa State University, n.d., https://www2.econ.iastate.edu/classes/econ308/tesfatsion/axeltmts.pdf.

by a unilateral change of strategy if others remain unchanged (i.e., the stochastic solution in a noncooperative game).[18] (*C,C*) is the Pareto optimal choice pair—no available action benefits one agent without the expense of another—driven by the criterion $2R > T + S$.

To model decisionmaking of agents through time, the game is iterated. If two agents play more than once in succession and remember previous actions of their opponent, they can modify a strategy accordingly and the game takes the form of the IPD. In an IPD game with at least two iterations, "always defect" is no longer a dominant strategy in response to every possible strategy an opponent might choose. The pursuit of a dominant strategy has motivated game theory research for decades.[19] Indeed, the study of effect choice underpins the objective of nuclear deterrence without catastrophic consequence.

The pseudo-code in Figure 1 implements a simple IPD tournament in the programming language Python. It takes a list of players as input and returns a dictionary of scores, where the key is the player's name and the value is the player's score. The tournament is run by selecting two players and having them play a round of the game. The scores are then updated based on the results of the round. The tournament is run for a predetermined number of rounds, unknown to the players. Scoring, shown in Figure 1(b), is consistent with the previous tournaments of Axelrod.[20]

A further variation of IPD incorporates more than two players. The n-person prisoner's dilemma considers a situation when each of n participants has a choice between cooperating with each other for the "common good" or defecting, with a similar scoring matrix between three players.

ADAPTED ITERATED PRISONER'S DILEMMA

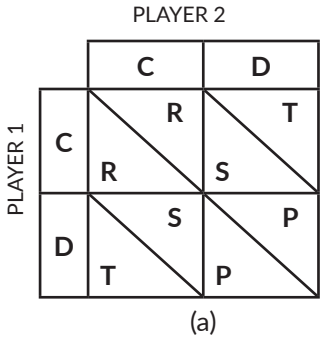
As discussed, modern nuclear decisionmaking is non-binary. Instead, it is a continuum between cooperation, collaboration, and competition.[21] The conflicts of today exist in a gray zone, often below the threshold of direct warfare. Thus, it becomes useful to adapt IPD to this reality. Previous attempts to model this dynamic include the addition of a neutral "opt-out" decision option.[22] Additionally, Jindong Nie et al. designed a gradually evolving score matrix that increased punishment over multiple steps.[23] This study expands the decision matrix by arbitrarily choosing five choices between fully cooperate "C2" and fully defect "D2," with a neutral option "N." Shown in Figure 2(a), it interpolates the scoring matrix from Axelrod among five choices.[24]

The pseudo-code in Figure 2 implements an IPD tournament in Python with five choices for players instead of two. This was developed using the "Axelrod" Python library.[25] This program provides over 230 classic IPD strategies (such as Tit-For-Tat and Win-Stay-Lose-Shift) and, using Monte Carlo

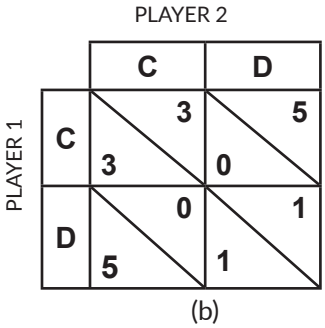
18 Nash, "Non-cooperative Games."
19 Nikoleta E. Glynatsi and Vincent A. Knight, "A bibliometric study of research topics, collaboration, and centrality in the iterated prisoner's dilemma," *Humanities and Social Sciences Communications* 8, no. 45 (February 2021), https://doi.org/10.1057/s41599-021-00718-9.
20 Axelrod, "Effective Choice in the Prisoner's Dilemma"; Robert Axelrod, "More Effective Choice in the Prisoner's Dilemma," *Journal of Conflict Resolution* 24, no. 3 (September 1980): 379–403, https://www.jstor.org/stable/173638; and Robert Axelrod, *The Evolution of Cooperation* (New York: Basic Books New York, 1984).
21 "Joint Doctrine Note 1-19: Competition Continuum," Joints Chief of Staff, June 3, 2019, https://www.jcs.mil/Portals/36/Documents/Doctrine/jdn_jg/jdn1_19.pdf.
22 Steven Kuhn, "Prisoner's Dilemma," in *The Stanford Encyclopedia of Philosophy*, Edward N. Zalta, ed. (Stanford, CA: Stanford University, updated April 2019), https://plato.stanford.edu/entries/prisoner-dilemma/.
23 Jindong Nie, Juan Wang, Haodong Niu, and Chengyi Xia, "Impact of multi-step punishment on the spatial prisoner's dilemma game," *Physics Letters A* 446 (September 2022): 128274, https://doi.org/10.1016/j.physleta.2022.128274.
24 Axelrod, "Effective Choice in the Prisoner's Dilemma."
25 Vince Knight et al., "Axelrod-Python/Axelrod: v4.12.0," Zenodo, 2021, https://doi.org/10.5281/zenodo.5616793.

methods, can create head-to-head matches between pairs of strategies or tournaments over a number of strategies. It is further optimized to study population dynamics through Moran processes and an infinite population model. This parametric study should provide clear answers regarding which strategies perform well in a strictly defined game.

Figure 1: (a) General Symmetric Payoff Matrix; (b) Explicit Scoring Matrix from Axelrod's First and Second Tournaments



(a)



(b)

```
class Player:
    def __init__(self, name):
        self.name = name
    def play(self, opponent):
        # Choose a move
        move =
... player.choice(["C2", "C1", "N", "D1", "D2"])
        # Return the move
        return move
...
def run_tournament(players):
    # Initialize the scores
    scores = {}
    for player in players:
        scores[player.name] = 0
         score1 = [3      3.5      4        4.5      5
                  2.25     2.6875   3.125    3.375    4
                  1.5      1.875    2.25     2.625    3
                  0.75     1.0625   1.375    1.6875   2
                  0        0.25     0.5      0.75     1]
         score2 = transpose(score1)
    # Play the tournament
    for i in range(1000):
        # Choose two random players
        player1 = random.choice(players)
        player2 = random.choice(players)
        # Play a round of the game
        move1 = player1.play(player2)
        move2 = player2.play(player1)
        # Update the scores
        if move1 == "C2" and move2 == "C2":
            scores[player1.name] += 3
            scores[player2.name] += 3
         for n1 = 1:5 and n2 = 1:5
        elif move1 == "x" and move2 == "y":
            scores[player1.name] += score1(x,y)
            scores[player2.name] += score2(x,y)
        else:
            scores[player1.name] += 1
            scores[player2.name] += 1
    # Return the results
    return scores
```

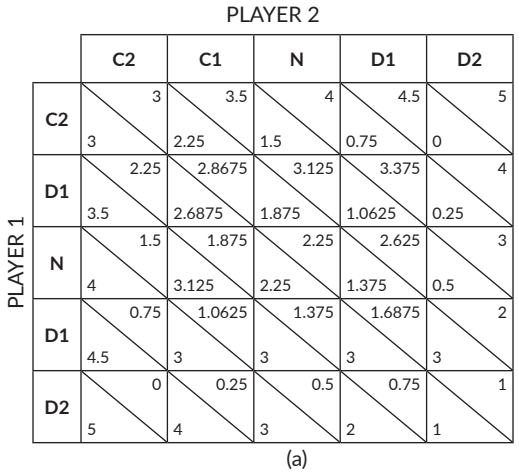
Source: Robert Axelrod, "Effective Choice in the Prisoner's Dilemma," *Journal of Conflict Resolution* 24, no. 1 (March 1980): 3–25, https://www.jstor.org/stable/173932.

PROPOSED STRATEGIES TO ACHIEVE STABILITY

A computer tournament provides the context to study effective choice in the IPD. Each entrant is a program that embodies a decision rule to select a choice on each move. The program has available to it the history of the game so far and may use this history in making a choice. The tournament is run in round-robin style, so that each entry is paired with each other entry. Each entry is also

paired with its own twin and with RANDOM, a program that randomly cooperates and defects with equal probability. Each game consists of an arbitrary number of moves (unknown to the players). For a game of 1,000 moves and 11 players, there are 65 pairs, 65,000 moves, and 130,000 separate choices. The tournament can be run multiple times to smooth random effects (with the distribution of results for 40 tournaments shown in Figure 3). As illustrated in Figure 2(b), decision pathways and computational cost scale with the number of players ~n(n-1)/2.

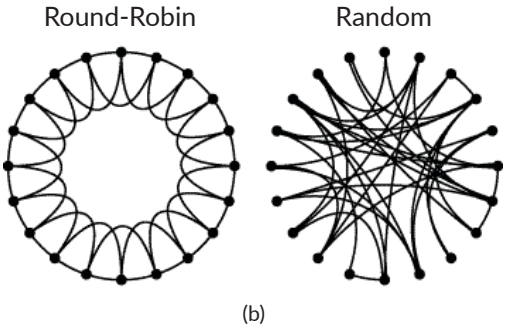
Figure 2: (a) Adapted Iterated Prisoner's Dilemma Scoring Matrix; (b) Round-Robin and Random Tournament Style



PLAYER 2

PLAYER 1	C2	C1	N	D1	D2
C2	3 / 3	3.5 / 2.25	4 / 1.5	4.5 / 0.75	5 / 0
D1	2.25 / 3.5	2.8675 / 2.6875	3.125 / 1.875	3.375 / 1.0625	4 / 0.25
N	1.5 / 4	1.875 / 3.125	2.25 / 2.25	2.625 / 1.375	3 / 0.5
D1	0.75 / 4.5	1.0625 / 3	1.375 / 3	1.6875 / 3	2 / 3
D2	0 / 5	0.25 / 4	0.5 / 3	0.75 / 2	1 / 1

(a)



(b)

```
class Player:
    def __init__(self, name):
        self.name = name

    def play(self, opponent):
        # Choose a move
        move =
... player.choice(["C2", "C1", "N", "D1", "D2"])

        # Return the move
        return move
...

def run_tournament(players):
    # Initialize the scores
    scores = {}
    for player in players:
        scores[player.name] = 0

     score1 = [3      3.5      4        4.5      5
               2.25   2.6875   3.125    3.375    4
               1.5    1.875    2.25     2.625    3
               0.75   1.0625   1.375    1.6875   2
               0      0.25     0.5      0.75     1]
     score2 = transpose(score1)
```

Source: Duncan J. Watts and Steven H. Strogatz, "Collective dynamics of 'small-world' networks," *Nature* 393, (June 1998): 440–442, https://doi.org/10.1038/30918.

Extensive research in classic IPD has identified four general properties common to successful strategies (i.e., for accumulating higher total payoffs):

- **Niceness**: Avoid being the first to defect.
- **Provocability**: Retaliate and punish defectors quickly.
- **Forgiveness**: Avoid grudges through iterations and defecting more than necessary to punish.
- **Clarity**: Act in ways that are straightforward (and predictable to some degree) to opponents.

Furthermore, an additional desirable feature in this study is *simplicity*. In applying game theory to real-world decisionmaking, it is presumably easier to draw lessons from elegant and simple strategies.[26]

In a stochastic IPD game, strategies can be described by a set of probabilities *P* which is a function of the outcomes of the previous iterated results (how many turns a strategy "looks back"). For a "memory-*n*" strategy, *P* is a function of only the most recent *n* turns, Therefore, a memory-1 strategy is specified by four cooperation probabilities $P=\{P_{CC},P_{CD},P_{DC},P_{DD}$ of only the previous turn. It has been shown that there is a statistically identical memory-1 strategy for any memory-n strategy, thus only memory-1 strategies are considered.[27]

Tit-for-Tat (TFT), one of the simplest strategies, came to dominate the early classic IPD tournaments. This strategy duplicates the choice of its opponent on the previous turn, thereby maximizing cooperations. Ironically, TFT does not have the ability to beat any opponent head-to-head, since the only opportunity to earn a higher score than an opponent is to defect more often.[28] However, in the tournament setting, it generalizes well against all variety of opponents.

Highly complex and advanced strategies have outperformed TFT in recent years. Adaptive Pavlov and Zero Determinant strategies seek to classify and exploit an opponent strategy.[29] Lee Worden and Simon A. Levin presented an evolutionary strategy to promote cooperation through changes to the payoff matrix over time.[30] Alessandro Bravetti and Pablo Padilla present an optimized replication equation that exploits population-level competition to promote cooperation among individuals.[31] Perhaps most deeply, quantum strategies exploit principles of superposition and entanglement to essentially communicate in intentions between players *a priori*.[32] As such, while these approaches provide great utility in the fields of physics and biology, application to nuclear deterrence is limited.

Eleven strategies originally proposed for classic IPD were adapted to the adapted iterated prisoner's dilemma (AIPD), shown in Table 1. These strategies were chosen because they are simple and many have performed well in classic IPD tournaments. Development and proposal of entirely novel strategies is beyond the scope of this study, but it is the hope that this work inspires such thought.

26 Axelrod, *The Evolution of Cooperation*; William H. Press and Freeman J. Dyson, "Iterated Prisoner's Dilemma contains strategies that dominate any evolutionary opponent," *Proceedings of the National Academy of Sciences* 109, no. 26 (May 2012): 10409–10413, https://doi.org/10.1073/pnas.1206569109; Glynatsi and Knight, "A bibliometric study of research topics, collaboration, and centrality in the iterated prisoner's dilemma"; and Tesfatsion, "Notes on Axelrod's Iterated Prisoner's Dilemma (IPD) Tournaments."

27 Press and Dyson, "Iterated Prisoner's Dilemma contains strategies that dominate any evolutionary opponent."

28 Rapoport, "Prisoner's Dilemma."

29 Kuhn, "Prisoner's Dilemma."

30 Lee Worden and Simon A. Levin, "Evolutionary escape from the prisoner's dilemma," *Journal of Theoretical Biology* 245, no. 3 (April 2007): 411–22, https://doi.org/10.1016/j.jtbi.2006.10.011.

31 Alessandro Bravetti and Pablo Padilla, "An optimal strategy to solve the Prisoner's Dilemma," *Scientific Reports* 8, no. 1948 (January 2018), https://doi.org/10.1038/s41598-018-20426-w.

32 Zhiyuan Dong and Ai-Guo Wu, "The Superiority of Quantum Strategy in 3-Player Prisoner's Dilemma," *Mathematics* 9, no. 12 (June 2021): 1443, https://doi.org/10.3390/math9121443.

Table 1: Simple Strategies Chosen for AIPD tournament

Strategy	Description	Python Pseudo-Code

Unconditional Cooperator (CU2)	Cooperate unconditionally	`class AlwaysCooperate(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  def play(self, opponent):`
		`  return "C2"`

Unconditional Defector (DU2)	Defect unconditionally	`class AlwaysDefect(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  def play(self, opponent):`
		`  return "D2"`

Random (RAND)	Random selection based in Mersenne Twister algorithm	`import random`
		`class Random(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  def play(self, opponent):`
		`  possible_moves = ["C2","C1","N","D1","D2"]`
		`  move = random.choice(possible_moves)`
		`  return move`

Tit for Tat (TFT)	Cooperate on the first round, imitate opponent's previous move thereafter	`class TFT(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  self.history = []`
		`  def play(self, opponent):`
		`  if len(self.history) == 0:`
		`  return "C2"`
		`  else`
		`  # Otherwise imitate`
		`  return opponent.history(n-1)`

Suspicious Tit for Tat (STFT)	Defect on the first round, imitate opponent's previous move thereafter	`class STFT(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  self.history = []`
		`  def play(self, opponent):`
		`  if len(self.history) == 0:`
		`  return "D2"`
		`  else`
		`  # Otherwise imitate`
		`  return opponent.history(n-1)`

Tit for Two Tats (TF2T)	Cooperate unless defected against twice in a row	`class TF2T(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  self.history = []`
		`  def play(self, opponent):`
		`  if len(self.history) == 0:`
		`  return "C2"`
		`  elif opponent.history(n-1) == "D2" OR "D1"`
		`  ... AND opponent.history(n-2) == "D2" OR "D1"`
		`  return "D2"`
		`  # Otherwise, cooperate.`
		`  else:`
		`  return "C2"`

Two Tits for Tat (2TFT)	Defect twice after being defected against, otherwise cooperate	`class 2TFT(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  self.history = []`
		`  def play(self, opponent):`
		`  if len(self.history) == 0:`
		`  return "C2"`
		`  elif opponent.history(n-1) == "D2" OR "D1"`
		`  return ["D2","D2"]`
		`  # Otherwise, cooperate.`
		`  else:`
		`  return "C2"`

Trigger (or Grim, GRIM)	Cooperate until opponent has defected once, then defect for the rest of the game	`class Grim(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  self.history = []`
		`  def play(self, opponent):`
		`  if len(self.history) == 0:`
		`  return "C2"`
		`  elif opponent.history(n-1) == "D2" OR "D1"`
		`  return "D2"`
		`  elif self.history(n-1) == "D2"`
		`  return "D2"`
		`  # Otherwise, cooperate.`
		`  else:`
		`  return "C2"`

Pavlov (Win-stay, Lose-shift, WSLS)	Cooperate if it and its opponent moved alike in previous move and defect if they moved differently	`class WSLS(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  self.history = []`
		`  def play(self, opponent):`
		`  if len(self.history) == 0:`
		`  return "C2"`
		`  elif opponent.history(n-1) == self.history(n-1)`
		`  return "C2"`
		`  # Otherwise, defect.`
		`  else:`
		`  return "D2"`

Prober (PROB)	Start with (D2, C2, C2) then defect if opponent has cooperated in the second and third move; otherwise, play TFT	`class Prob(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  self.history = []`
		`  def play(self, opponent):`
		`  if len(self.history) == 0:`
		`  return ["D2","C2","C2"]`
		`  elif opponent.history(2) == "C2" OR "C1"`
		`  ... AND opponent.history(3) == "C2" OR "C1"`
		`  return "D2"`
		`  # Otherwise, TFT.`
		`  else:`
		`  return opponent.history(n-1)`

Grudge (GDG)	Cooperate until opponent defects, then punish with (D2, D2, D2, D2, C2, C2)	`class GDG(Player):`
		`  def __init__(self, name):`
		`  super().__init__(name)`
		`  self.history = []`
		`  def play(self, opponent):`
		`  if len(self.history) == 0:`
		`  return "C2"`
		`  elif opponent.history(n-1) == "D2" OR "D1"`
		`  return ["D2","D2","D2","D2","C2","C2"]`
		`  # Otherwise, cooperate.`
		`  else:`
		`  return "C2"`

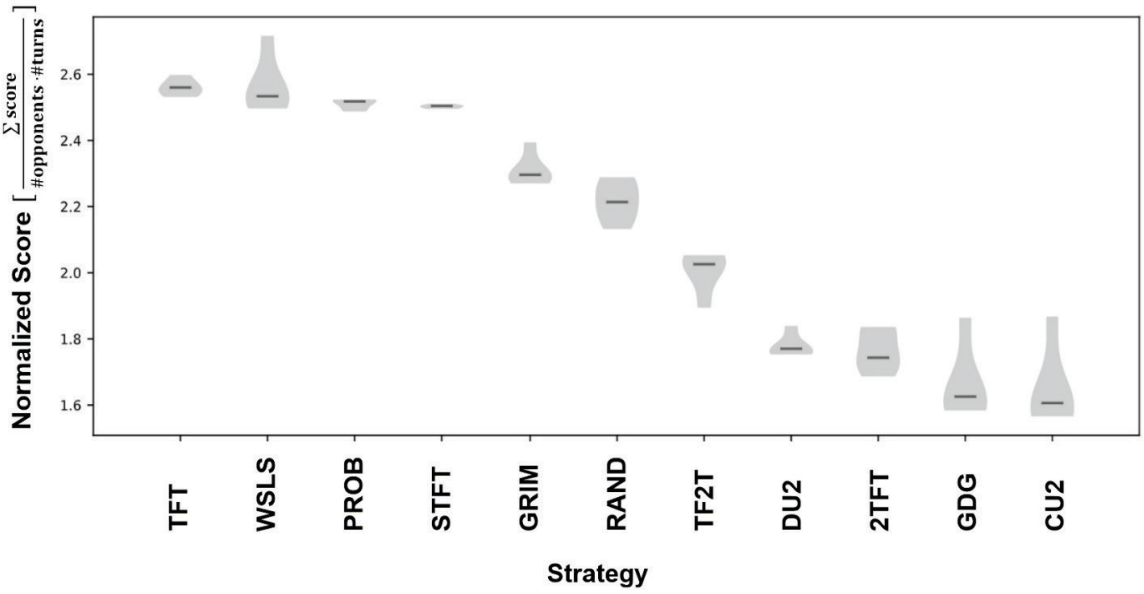
Source: Steven Kuhn, "Prisoner's Dilemma," in *The Stanford Encyclopedia of Philosophy*, Edward N. Zalta, ed. (Stanford, CA: Stanford University, updated April 2019), https://plato.stanford.edu/entries/prisoner-dilemma/; Buster Benson, "A prisoner's dilemma cheat sheet," Medium, July 29, 2018, https://medium.com/thinking-is-hard/a-prisoners-dilemma-cheat-sheet-4d85fe289d87; and Vince Knight et al., "Axelrod-Python/Axelrod: v4.12.0," Zenodo, 2021, https://doi.org/10.5281/zenodo.5616793.

RESULTS SHOW HISTORICAL CONSISTENCY

Figure 3 shows the results of an IPD computer tournament: the normalized score (cumulative score averaged per opponent and number of turns) for each of the 11 strategies entered. The violin plot also shows the distribution of results over 40 games. It is clear that the strong strategies in classic IPD (e.g., TFT and Pavlov) are dominant. TFT, while never winning heat-to-head, obtained the highest score by prioritizing cooperation over attempts to maximize one's individual score

and explicit agreements.[33] Similarly Pavlov showed a broad distribution of favorable scores, due to its effectiveness at exploiting the numerous TFT variant strategies. Broadly the poor-performing strategies can be classified as either too punitive (2TFT, DU2, GDG) or too exploitable (TF2T, CU2).

Figure 3: Results of Round-Robin IPD Tournament with "Axelrod" Python Library



Source: Vince Knight et al., "Axelrod-Python/Axelrod: v4.12.0," Zenodo, 2021, https://doi.org/10.5281/zenodo.5616793.

CONCLUSIONS AND LIMITATIONS IN THEORY AND ANALYSIS

This study proposes an adaptation of IPD—AIPD—to better model a multiplicity of decision options between agents, with particular relevance to twenty-first-century nuclear deterrence. The game can be implemented using a round-robin tournament with entrants adapted from simple strategies of the classic prisoner's dilemma. Conclusions and limitations include the following:

- The criteria first outlined by Axelrod for competitive strategies remains true in this context. Real-world decisions and nuclear learning must emphasize niceness, provocability, forgiveness, and clarity.
- The expansion of IPD to five discrete decision options (*C2, C1, N, D1, D2*) was arbitrary. Five discrete options were chosen to demonstrate a range of options for each player. It is unlikely that a greater number of discrete choices would affect optimal strategies. However, to further model a choice continuum, it may be revealing to model decisions as common distributions with probability density functions rather than as discrete values.
- The scoring matrix was arbitrary. It met the general criteria : $T > R > P > S$ and $2R > T + S$ and was interpolated from the historical precedent of Axelrod's tournament. Explicit justification of these values may be required.
- Only a select few strategies were entered into the tournament. They were chosen due to their simplicity and ease of adaptability from classic IPD (with Pavlov and TFT historically dominant).

33 Rapoport, "Prisoner's Dilemma."

Further pursuit of winning strategies may be of interest, including adapting more complex strategies, such as Adaptive Pavlov and Optimal Replicator. Further, there should be a search for novel winning strategies that did not emerge in the classic IPD game. However, the bias should be toward simpler strategies, as the learning utility diminishes with complexity. It is easier to link simple concepts with policy and real-world decisionmaking.

- AIPD could also be developed to take the form of the *n*-player prisoner's dilemma, where each of *n* participants has a choice between cooperation with each other for the "common good" or defection. This could model multipolar great power competition and decisionmaking (the "two-peer problem" of China-Russia-U.S. three-party deterrence dynamics), as a "trilemma" game.

FURTHER QUESTIONS: LINKING STRATEGY WITH POLICY

Rational agents seek effective choice, but how do nation-states make choices? How can winning strategies take the form of real-world policy positions? What rewards and punishments can be offered? How can tools such as economic sanctions, long-range sensors, and malware and other cyber weapons be best optimized to counter the new threats Russian weapons pose? To what instruments of power would these weapons be most vulnerable? How can ideas of honor and moral restraint (poorly modeled in simulation) be accounted for in decisionmaking and strategic interactions among rational agents? AIPD is merely an example case to model the substantial increase in decision complexity of contemporary deterrence. An era of geopolitical realities and military capabilities demands new methods.

Evaluating Developments and Capabilities beyond the United States

The Prospect of Risk Manipulation from China's Nuclear-Conventional Entanglement

By Elliot Ji[1]

INTRODUCTION

Since its first nuclear test in 1964, China has assigned a limited mission of strategic retaliation to its nuclear forces.[2] To Chinese leaders, having nuclear weapons was about securing the regime from nuclear coercion and deterring nuclear first strikes from other nuclear nations through assured retaliation.[3] As such, China has been content with a small strategic nuclear force with low levels of alertness and a strong no-first-use pledge.[4] At least until President Xi Jinping's rapid expansion of the Chinese nuclear arsenal, nuclear weapons development in China focused primarily on the qualitative demand of protecting China's secure second strike and ensuring the penetration of enemy missile defense. The Chinese government often cites these practices as evidence of serving as a stabilizing force in international nuclear security.[5]

1 Elliot Ji is a PhD candidate in the Department of Politics at Princeton University.
2 Vipin Narang, *Nuclear Strategy in the Modern Era: Regional Powers and International Conflict* (Princeton, NJ: Princeton University Press, 2014), chap. 5.
3 M. Taylor Fravel, *Active Defense* (Princeton, NJ: Princeton University Press, 2019), chap. 8.
4 Hans M. Kristensen and Matt Korda, "Chinese Nuclear Weapons, 2021," *Bulletin of the Atomic Scientists* 77, no. 6 (November 2021): 318–36, https://doi.org/10.1080/00963402.2021.1989208.
5 Jia Wang, "China's Views on the Road Map to Nuclear Disarmament" in *Understanding Chinese Nuclear Thinking*, Li Bin and Tong Zhao, eds. (Washington, DC: Carnegie Endowment for International Peace, 2016), https://carnegieendowment.org/files/ChineseNuclearThinking_Final.pdf; and Xiangli Sun, "The Development of Nuclear Weapons in China" in *Understanding Chinese Nuclear Thinking*.

However, China's nuclear posture was not free of concerning practices even before the recent discovery of new missile silos in China. One of these practices has been the continued use of nuclear-conventional entanglement by the People's Liberation Army Rocket Force (PLARF), such as the deployment of dual-capable intermediate-range ballistic missiles (IRBMs) and the co-mingling of nuclear and conventional command and control (C2) systems.[6] Several leading Western scholars believe that entanglement creates a significant danger to nuclear strategic stability because it generates ambiguity in crisis nuclear decisionmaking regarding the missile payload and strike target for both sides.[7] The United States, for instance, has been acutely aware of the risks and has been reluctant to blur the nuclear-conventional line when developing new weapons systems.[8]

To the dismay of U.S. experts, the Chinese perception of entanglement diverges substantially from the U.S. view. On the one hand, Chinese scholars recognize the risk of inadvertent escalation in entanglement in the U.S. and Soviet contexts but tend to dismiss the risks of inadvertent escalation for China.[9] Chinese academic writings rarely discuss how entanglement applies to Chinese strategic forces. On the other hand, the Chinese government and official media take pride in successfully developing and deploying dual-capable weapon systems, particularly the DF-26 IRBM for its dual capability (*hechang jianbei* 核常兼备). At the 2019 70th National Day military parade, the Chinese official media described the DF-26 system as the "foundational and core strength" of the intermediate- and long-range strike forces of the PLARF, suggesting that China is not concerned with the issue of target or warhead ambiguity at the political level.[10] This general disregard for entanglement risk among Chinese experts and leadership has been well documented by scholars of strategic studies.[11] As of 2023, China continues to expand its entangled nuclear assets, with more dual-capable ballistic missiles entering service in the coming years.[12]

If entanglement is here to stay, what can it do for China's nuclear strategy? This analysis revisits the scholarly debate on the drivers and strategic risks of Chinese entanglement. In addition to detailing why China began entangling its nuclear forces, studies should also assess how China may

6 See the findings on DF-26 brigades in Xiu Ma, *PLA Rocket Force Organization* (Montgomery, AL: China Aerospace Studies Institute, Air University, October 24, 2022), https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/PLARF/2022-10-24%20PLARF%20Organization.pdf.

7 James M. Acton, "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War," *International Security* 43, no. 1 (2018): 56–99, https://doi.org/10.1162/isec_a_00320; James M. Acton, *Is It a Nuke?: Pre-Launch Ambiguity and Inadvertent Escalation* (Washington, DC: Carnegie Endowment for International Peace, April 2020), https://carnegieendowment.org/2020/04/09/is-it-nuke-pre-launch-ambiguity-and-inadvertent-escalation-pub-81446; and Vipin Narang, "The Discrimination Problem: Why Putting Low-Yield Nuclear Weapons on Submarines Is So Dangerous," War on the Rocks, February 8, 2018, https://warontherocks.com/2018/02/discrimination-problem-putting-low-yield-nuclear-weapons-submarines-dangerous/.

8 James M. Acton, *Silver Bullet?: Asking the Right Questions about Conventional Prompt Global Strike* (Washington, DC: Carnegie Endowment for International Peace 2013), https://carnegieendowment.org/2013/09/03/silver-bullet-asking-right-questions-about-conventional-prompt-global-strike-pub-52778; and National Research Council, *U.S. Conventional Prompt Global Strike: Issues for 2008 and Beyond* (Washington, DC: National Academies Press, 2008), https://doi.org/10.17226/12061.

9 Tong Zhao and Bin Li, "The Underappreciated Risks of Entanglement: A Chinese Perspective" in *Entanglement: Russian and Chinese Perspectives on Non-Nuclear Weapons and Nuclear Risks*, James M. Acton, ed. (Washington, DC: Carnegie Endowment for International Peace, 2017), 47–76, https://carnegieendowment.org/2017/11/08/entanglement-chinese-and-russian-perspectives-on-non-nuclear-weapons-and-nuclear-risks-pub-73162.

10 "东风-26核常兼备导弹方队：核常兼备的新型战略利器" [DF-26 dual-use missile squad: New dual-use strategic weapon], 新华社 [Xinhua Agency], October 1, 2019, http://www.xinhuanet.com/politics/2019-10/01/c_1125063262.htm.

11 Zhao and Li, "The Underappreciated Risks of Entanglement"; and Zhenqiang Pan, "China's No First Use of Nuclear Weapons," in *Understanding Chinese Nuclear Thinking*.

12 U.S. Department of Defense, *Military And Security Developments Involving The Peoples Republic Of China (CMPR), Annual Report to Congress* (Washington, DC: Department of Defense, 2023), 67, https://media.defense.gov/2022/Nov/29/2003122279/-1/-1/1/2022-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.

use entanglement and other risk-inducing practices for its own strategic gain, possibly through manipulating risks and divergent perceptions. Entanglement opens options for crisis signaling and, in extreme cases, tactical nuclear use, regardless of the initial motivation. Therefore, the literature should explore ways that the entangled systems are available to Chinese decisionmakers in a potential crisis scenario. This paper reviews existing studies on drivers of entanglement and notes how elements of entanglement can serve China's strategic and tactical interests even if they were not deliberately pursued during the early phases of China's nuclear programs. Entanglement as risk manipulation, despite being previously considered a theoretical possibility for why China began to entangle without direct textual or operational evidence, nevertheless offers an essential perspective on what China could do with its nuclear signaling in a crisis scenario that other explanations could not. The conclusion discusses the implications of this observation for U.S. deterrence posture vis-à-vis China in the context of China's rapid nuclear buildup.

WHY ENTANGLE? DRIVERS OF CHINESE ENTANGLEMENT

The academic debate on Chinese entanglement offers three non-mutually-exclusive candidate theories as to why China entangled its nuclear and conventional missile forces. The first is the theory of developmental cost efficiency or organizational convenience, which posits that dual-use missiles were adopted because they were easier to develop using the same missile body previously used for a conventional missile.[13] By reusing the same missile technology for IRBMs and medium-range ballistic missiles (MRBMs), the Chinese defense industry can save costs and ensure higher reliability using already mature missile technology. Using the same missile functionally to deliver different warheads also makes organizational and servicing sense. As David Logan found in a comprehensive analysis of entanglement within the People's Liberation Army (PLA), Chinese-language sources support this explanation, especially for the DF-26 dual-use IRBM, which features the flexibility to serve both conventional and nuclear deterrence missions.[14]

The second theory of Chinese entanglement draws from the broad literature of interservice rivalry. Scholars who argue for this school of thought contend that entanglement was the byproduct of the then Second Artillery Corps' attempt to monopolize the nuclear mission. The nuclear mission was political leverage for the top brass of China's missile forces to assert influence over PLA mission planning during the transition to theater commands.[15] In this sense, entanglement could help the PLARF's monopoly of land-based ballistic missile forces and prevent the army from gaining control of the ballistic missile fleet.[16]

While these two theories have some empirical support, they focus more on explaining how China initially decided to entangle, but less on how China could use entanglement for military and strategic advantage. In other words, understanding how China decided to entangle only tells half of the story about what entanglement means for China's nuclear strategy. The other half is what the country can do with these entangled systems after they enter service. After all, these two theories provide only a static picture of the Chinese considerations on nuclear entanglement. In regards to engagement, both

13 David C. Logan, "Are They Reading Schelling in Beijing? The Dimensions, Drivers, and Risks of Nuclear-Conventional Entanglement in China," *Journal of Strategic Studies* 46, no. 1 (2020): 35, https://doi.org/10.1080/01402390.2020.1844671.
14 Ibid., 36.
15 Phillip C. Saunders and Joel Wuthnow, "China's Goldwater-Nichols?: Assessing PLA Organizational Reforms," *Joint Force Quarterly* 82 (2016): 8, https://ndupress.ndu.edu/JFQ/Joint-Force-Quarterly-82/Article/793267/chinas-goldwater-nichols-assessing-pla-organizational-reforms/.
16 Logan, "Are They Reading Schelling in Beijing?," 36–37.

interservice and bureaucratic reasons and research and development (R&D) convenience reasons are hardly responsive to changes in a threat environment and decisionmaking calculus, which in turn cannot be used to inform how understanding the motivation of entanglement affects China's nuclear crisis behavior. The U.S. strategic community, however, would benefit the most from an explanation that accounts for how China may use its entangled forces in addition to why China might want them in the first place.

This leads to a third approach, which this analysis contends is the most useful to help understand entanglement as a component of Chinese nuclear strategy: the risk manipulation explanation. This theory posits that entanglement takes advantage of the Western concern of inadvertent nuclear escalation to preserve China's small nuclear force.[17] By intentionally co-locating nuclear and conventional missile systems, China can credibly demonstrate that even a conventional attack on these locations will invariably degrade Chinese retaliatory capabilities, generating a "use-it-or-lose-it" pressure on China's side. The United States, perceived by Chinese scholars as having more at stake, will then have to avoid these targets to reduce the risk of escalation.[18] In this sense, entanglement can deter the United States from striking high-value conventional targets by engendering a potential nuclear risk.

While leading studies on Chinese entanglement dismiss this theory, citing a lack of textual evidence and that China's entanglement would have been greater (whole entanglement of both weapons and nuclear C2 would maximize risk manipulation), the effect of risk manipulation may still be felt as long as China practices entanglement.[19] Whether China intended to manipulate risks when it initially planned the missile R&D is not the biggest concern. Instead, the most significant implication for U.S. strategy is whether China can effectively exploit Western concern of escalation.

RISK MANIPULATION AS AN OPTION

Given entanglement, can China employ a risk-manipulation strategy to deter attacks on its mobile missile forces? To answer this question, this analysis conceptualizes what it takes to manipulate risks to deter an adversary. In Thomas Schelling's logic, risk manipulation is essentially deterrence by punishment contingent on the credible threat that the choice to trigger a risky outcome lies in the hands of the deterred. If an adversary chooses to attack, then it must accept that doing so will result in a disproportionately large blow to itself.[20] The core task of deterrence through risk manipulation is thus to create a credible threat to escalate.

For China, several options are available to convey the credibility of such a threat. The first is that China has a small, arguably vulnerable arsenal for which China's expert community has consistently expressed survivability concerns under conventional U.S. precision strikes.[21] This, along with

17 Caitlin Talmadge, "Beijing's Nuclear Option," *Foreign Affairs*, October 15, 2018, https://www.foreignaffairs.com/articles/china/2018-10-15/beijings-nuclear-option.

18 P.W. Singer and Xiu Ma, "China's Ambiguous Missile Strategy Is Risky," Popular Science, May 11, 2020, https://www.popsci.com/story/blog-network/eastern-arsenal/china-nuclear-conventional-missiles/. For the core theory on the role of stake in nuclear bargaining, see Thomas C. Schelling, *Arms and Influence* (New Haven, CT: Yale University Press, 1966), chap. 3.

19 Indeed, China could easily move to co-locate currently separated nuclear and conventional forces to achieve this risk-manipulation effect during a crisis.

20 Schelling, *Arms and Influence*, chap. 2; and Thomas C. Schelling, *The Strategy of Conflict* (Cambridge, MA: Harvard University Press, 1960), chap. 8.

21 王政达 [Zhengda Wang], "中美复合核战略稳定关系：建构依据、基本框架与发展趋势" [U.S.-China integrated strategic stability: Evidence of construction, fundamental framework, and developmental pattern], 国际安全研究 [International Security Studies], no. 5 (2019); Keir A. Lieber and Daryl G. Press, "The New Era of Counterforce: Technological Change and the

scholars that argue for the viability of the U.S. counterforce strategy, acknowledges that Chinese nuclear forces have had a persistent vulnerability to preemptive strikes and thus can credibly threaten to escalate when U.S. strikes on entangled systems bring on a "use-it-or-lose-it" pressure. Indeed, Chinese authors have repeatedly shown that superior U.S. conventional precision-strike and targeting capabilities, for instance, would significantly undermine China's confidence in its ability to conduct retaliatory nuclear strikes against the United States.[22] The stakes for a nuclear state with comparatively lesser nuclear capabilities such as China are much higher when losing certain conventional systems amounts to losing nuclear capabilities under entanglement. Chinese strategic writings support this point. Yang Yuan at the Chinese Academy of Social Sciences wrote that having a limited, seemingly insufficient nuclear retaliatory force could paradoxically enhance the credibility of the intention to escalate, precisely because losing nuclear-capable platforms can amount to a demonstrable credible threat of escalating to nuclear use—China simply cannot afford to absorb the damage or wait until the enemy uses nuclear weapons first.[23] This allows China to issue credible statements that the stakes are indeed higher for China and that China can be expected to escalate disproportionately. Currently, China is already building a robust launch-on-warning (预警反击) capability with new silos and radar systems, indicating a potential increase in peacetime readiness levels and a willingness to escalate if its nuclear survivability is threatened.[24]

Second, China can show that it has a fleet of technologically sophisticated missiles that can survive U.S. attacks and land a limited nuclear strike in the theater. Based on the current estimations of PLARF capabilities, there is little doubt that China could launch theater-range weapons to reach as far as U.S. forces in Guam.[25] Chinese IRBMs are also mobile units that can be dispersed during crises. The DF-26, because of its range and mobility, can be fired from remote, hard-to-detect regions deep inside Chinese territories to undermine enemy long-range strike effectiveness.[26] In terms of the readiness levels for the dual-mission DF-26 units, recent open-source intelligence suggests that at least one DF-26 brigade (Brigade 646 in Lanzhou) has already demonstrated the ability to carry out both conventional and nuclear strike missions, potentially indicating that all other known DF-26

Future of Nuclear Deterrence," *International Security* 41, no. 4 (April 2017): 9–49, https://doi.org/10.1162/ISEC_a_00273; Riqiang Wu, "Living with Uncertainty: Modeling China's Nuclear Survivability," *International Security* 44, no. 4 (April 2020): 84–118, https://doi.org/10.1162/isec_a_00376; Zhao and Li, "The Underappreciated Risks of Entanglement"; and Tong Zhao, "What the United States Can Do to Stabilize Its Nuclear Relationship with China," *Bulletin of the Atomic Scientists* 75, no. 1 (2019): 19–24, https://doi.org/10.1080/00963402.2019.1555992.

22 Research of both U.S. and Chinese scholars reflects this point. For the Chinese perspectives, see 陈曦 [Xi Chen], 葛腾飞 [Tengfei Ge], and 宋道清 [Daoqing Song], "智能化情报手段对大国战略稳定的影响评估" [An assessment of the impact of intelligent intelligence means on the strategic stability of great powers], 情报杂志[Journal of Intelligence] 40, no. 6 (June 2021): 11–19; 王志军 [Zhijun Wang] and 张耀文 [Yaowen Zhang], "中美核战略稳定问题研究" [Research on the nuclear strategic stability of Sino 一 America], 学术探索 [Academic Exploration], no. 10 (October 2016): 44–58; 李文杰 [Wenjie Li] and 牛文[Wen Niu], "高超声速打击武器突防能力浅探" [A brief exploration of the defense-penetrating capabilities of hypersonic strike weapons], 飞航导弹 [Cruise Missile], no. 7 (2013): 8–11; and 汪丰麟 [Fenglin Wang] et al., "高超声速武器防御体系的发展现状与演进趋势" [Development status and trends of hypersonic weapon defense system], 指挥控制学报 [Journal of Command and Control] 8, no. 4 (December 2022).

23 杨原 [Yuan Yang], "超越 '确保摧毁' ：核武器数量、承诺可信度与核威慑原理" [Beyond assured destruction: quantity of nuclear weapons, commitment credibility and rationale of nuclear deterrence], 国际安全研究 [International Security Studies], no. 5 (2021): 23–24.

24 U.S. Department of Defense, *Military And Security Developments Involving The Peoples Republic Of China (CMPR)*, 104.

25 Hans M. Kristensen, "China's New DF-26 Missile Shows Up At Base In Eastern China," Federation Of American Scientists, January 21, 2020, https://fas.org/blogs/security/2020/01/df-26deployment/; "Missiles of China," Missile Threat, CSIS, n.d., https://missilethreat.csis.org/country/china/; and Decker Eveleth, *People's Liberation Army Rocket Force Order of Battle 2023* (Monterey, CA: Middlebury Institute for International Studies at Monterey, July 2023), https://nonproliferation.org/peoples-liberation-army-rocket-force-order-of-battle-2023/; and ibid.

26 U.S. Department of Defense, *Military And Security Developments Involving The Peoples Republic Of China (CMPR)*, 65.

brigades are also trained to do the same.[27] China currently operates more than 200 units of DF-26 missiles, with 100 more in production.[28] The weapons under development also show promise for nuclear applications. Though little information is publicly available, the DF-21E and DF-17 MRBMs are both expected to be nuclear capable and share the same mobile features. The DF-17 is further enabled with a hypersonic glide vehicle, which bolsters its defense penetration capabilities.[29] The most recent estimation by the U.S. Department of Defense already indicates a growth in these theater-range systems.[30] In sum, there is little doubt that China has and can preserve the necessary weapons to make good on the "punishment" should deterrence fail, primarily made possible by exploiting dual-use missiles and other entangled platforms.

Lastly, the PLA could also artificially inflate the degree of entanglement as the crisis unfolds to create more "co-location" if needed to induce U.S. caution. This is admittedly a hypothetical scenario, but as U.S. precision strikes begin to reach deep into the Chinese mainland, one could easily imagine that China could conceal dual-use missile units or C2 infrastructure near high-value strategic targets such as nuclear power plants, major water dams, or critical political and economic centers, all of which are outlined by the authoritative text of *The Science of Second Artillery Campaigns* as targets that could justify the adjustment of China's nuclear policy and signaling.[31] This would present a significant political problem for U.S. military leaders, especially when the United States seeks to contain the conflict strictly at the conventional level. This would complicate U.S. targeteering that aims to eliminate long-range PLARF missiles using conventional precision strikes.

None of the analyses above contradict existing theories on why China entangled its nuclear forces at the time when the R&D programs that made entanglement possible (e.g., sharing missile bodies, integrated C2, and hot-swapping warheads) began to form. They simply show that the continuing practice of entanglement permits China the opportunity to create a credible deterrence through risk manipulation. While the Chinese leadership might not deliberately incorporate risk manipulation when building China's nuclear forces, this option is available should a crisis arise.

CONCLUSION AND IMPLICATIONS

This analysis attempts to revive risk manipulation as a perspective through which to understand Chinese entanglement. Understanding the developmental history of Chinese entanglement is only half of the puzzle. The other half is what purpose—whether it is strategic deterrence or political coercion—these entangled systems hold for China. In this sense, understanding entanglement as a potential element of a risk manipulation strategy is useful to inform U.S. strategy.

Two important implications emerge from the discussion of risk manipulation. First, since the concern of inadvertent escalation between the two countries only seems to burden the United States, continuing this unilateral risk appreciation only enriches Chinese strategic success. China can leverage this unilateral risk perception and deter U.S. precision strikes on dual-use systems by either passively leveraging their entangled nature or intentionally positioning them near high-value

27 Ma, *PLA Rocket Force Organization*, 129–31.
28 Kristensen and Korda, "Chinese Nuclear Weapons, 2021."
29 Ankit Panda, "Introducing the DF-17: China's Newly Tested Ballistic Missile Armed With a Hypersonic Glide Vehicle," *The Diplomat*, December 28, 2017, https://thediplomat.com/2017/12/introducing-the-df-17-chinas-newly-tested-ballistic-missile-armed-with-a-hypersonic-glide-vehicle/.
30 U.S. Department of Defense, *Military And Security Developments Involving The Peoples Republic Of China (CMPR)*.
31 于际训 [Yu Jixun], ed., 第二炮兵战役学[The Science of Second Artillery Campaigns] (Beijing: PLA Press, 2004), 294–96.

or dual-use locations. The fear of inadvertently degrading Chinese nuclear capabilities can thus turn into a Chinese deterrence asset and continue to motivate China to engage in high-risk nuclear signaling and practices such as entanglement. Over the last 30 years, China has been willing to show its risk tolerance and leverage the prudence of the United States and its allies. Chinese warplanes and naval vessels have persistently adopted a precarious mode of operation to assert dominance and repel U.S. assets operating near Chinese territory, in part motivated by the perception that the United States would rather not risk any escalation.[32] In response, the United States must demonstrate a firm resolve to call out when China is responsible for creating unnecessary risks. This could be done politically or diplomatically using various channels to emphasize that risk manipulation will only invite a crisis that will be quite costly for the Chinese regime.

Second, as China rapidly expands its nuclear arsenal, it could improve the overall survivability of China's nuclear forces and subsequently ease the "use-it-or-lose-it" pressure on Chinese leaders. A larger arsenal with many more land-based intercontinental systems and a growing number of mobile intermediate-range systems could assure the Chinese leadership that they could afford to lose some theater-range nuclear-capable weapons and C2 nodes while still having an intact, assured retaliatory strike. Chinese scholars, including former PLA ballistic missile engineer Wu Riqiang, note that Chinese nuclear strategy does not have to follow the world-ending logic of mutually assured destruction, which requires many high-yield weapons, but may suffice to use an assured non-zero retaliation logic, which ensures that some Chinese warheads will land on the U.S. homeland. In other words, as long as the United States cannot be certain that none of China's nuclear weapons could survive a counterforce strike, the United States will not be incentivized to engage in a preemptive first strike against Chinese nuclear systems.[33] This implicitly shows that China is willing and able to absorb some damage to its nuclear forces (perhaps more so as it acquires over 1,000 warheads by 2035). Therefore, the United States should not overemphasize the inadvertent escalation risks from entanglement when planning strike packages. Political and diplomatic engagements remain essential not only to maintain crisis stability but also to explicitly call out China's risk-taking behaviors and detail the consequences of risk manipulation. Should China decide to employ this strategy during crises, the counter to risk manipulation is a firm assurance of action and consequences.

32 Mark E. Redden and Phillip C. Saunders, *Managing Sino-U.S. Air and Naval Interactions: Cold War Lessons and New Avenues of Approach* (Washington, DC: Institute for National Strategic Studies, National Defense University, September 2012), *China Strategic Perspectives* no. 5, https://apps.dtic.mil/sti/pdfs/ADA568028.pdf.

33 Riqiang Wu, "Certainty of Uncertainty: Nuclear Strategy with Chinese Characteristics," *Journal of Strategic Studies* 36, no. 4 (2013): 579–614, https://doi.org/10.1080/01402390.2013.772510.

India's Missile Defense

Myths vs. Realities

By Samanvya Singh Hooda[1]

Beyond recent tensions in Ukraine, the India-Pakistan dyad arguably has the lowest threshold for nuclear weapons use. While some experts argue that missile defense aligns with India's nuclear posture, others argue that it is not worth the trouble.[2] Christopher Clary and Vipin Narang argue that the combination of missile defense and counterforce capabilities makes the India-Pakistan dyad more volatile.[3] Others deride the same combination for increasing nuclear instability by weakening Pakistan's nuclear deterrent.[4] This paper argues that India's current and future missile defense is not destabilizing for three reasons:

1. extensive, successful boost-phase missile defense is near-impossible;
2. midcourse discrimination of penetration aids and warheads is extremely difficult; and
3. India does not have the resources to successfully develop counterforce capabilities and multilayered missile defense to guarantee national missile defense.

These considerations, in conjunction with earlier research, raise questions about the drivers behind Pakistan's nuclear modernization. Conventional wisdom suggests that Pakistan's security environment—its threat perceptions of India—shapes its nuclear posture. However, if India's military capabilities do not threaten Pakistan's deterrent, what else influences Pakistan's nuclear posture? Is there merely a perceptual gap, or are there other drivers?

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2 Balraj Nagal, "India and Ballistic Missile Defense: Furthering a Defensive Deterrent," Carnegie Endowment for International Peace, June 30, 2016, https://carnegieendowment.org/2016/06/30/india-and-ballistic-missile-defense-furthering-defensive-deterrent-pub-63966; and Frank O'Donnell and Yogesh Joshi, "India's Missile Defense: Is the Game Worth the Candle?," *The Diplomat*, August 2, 2013, https://thediplomat.com/2013/08/indias-missile-defense-is-the-game-worth-the-candle/.

3 Christopher Clary and Vipin Narang, "India's Counterforce Temptations: Strategic Dilemmas, Doctrine, and Capabilities," *International Security* 43, no. 3 (Winter 2019): 7–52, https://doi.org/10.1162/isec_a_00340.

4 Probal Ghosh, "Is Missile Defence Destabilizing for South Asia?," *RUSI Journal* 150, no. 5 (October 2005): 54–59, https://doi.org/10.1080/03071840509431885.

This paper examines the feasibility of boost-phase defense for India, the costs associated with midcourse and terminal defenses, and related implications for the study of Pakistan's nuclear posture. The burnout times and interceptor costs are representative estimates. Altogether, it would be extremely difficult for Indian missile defense to seriously threaten Pakistan's nuclear deterrent, and it would be foolhardy to try.

BOOST-PHASE MISSILE DEFENSE AGAINST PAKISTAN

This study is made difficult by limited open-source and unclassified information about Indian and Pakistani missile capabilities. For illustrative purposes, Pakistan's missiles have been compared to missiles of similar range. Since most comparable missiles are liquid fueled, as opposed to the solid-fueled missiles that Pakistan is inducting, actual burnout times will be even lower. However, even these inflated numbers show that Indian boost-phase missile defense against Pakistan is infeasible.

Table 1: Burnout Times of Pakistani Missiles

Name	Range	Description	Estimated Number	Comparable Missile	Burnout Time of Comparable Missile
Hatf 2	180–200 km	Single-stage, solid-fueled	10	Scud-C	61 seconds
Shaheen 2	1,500 km	Two-stage, solid-fueled	16	~Nodong 1	95 seconds +
Shaheen 3	2,750 km	Two-stage, solid-fueled	0 confirmed, pending deployment	Taepodong-1	165 seconds
Ghauri	1,250 km	Single-stage, liquid-fueled	24	Nodong 1	95 seconds
Abadeel	2,200 km	MIRV-capable; uncertain if liquid- or solid-fueled	0 confirmed, pending deployment	Taepodong-1	165 seconds

Source: Range and estimated number taken from Hans M. Kristensen and Matt Korda, "Pakistan Nuclear Weapons 2021," *Bulletin of the Atomic Scientists* 77, no. 5 (September 2021): 265–78, https://doi.org/10.1080/00963402.2021.1964258; comparable platforms taken from "Missile Threat," *Missile Threat*, CSIS, https://missilethreat.csis.org/; and burnout time taken from Dean A. Wilkening, "Airborne Boost-Phase Ballistic Missile Defense," *Science and Global Security* 12, no. 1 (2004), https://doi.org/10.1080/08929880490464649.

Successful boost-phase interceptions require excellent intelligence, surveillance, and reconnaissance (ISR), as well as fast-accelerating interceptors proximate to the launch area. Interceptors can include ground-based, air-launched, or space-based systems. This analysis does not consider space-based interceptors because of the exorbitant costs involved with such platforms, although reduced space-launch costs could make them feasible over the next few decades.[5]

5 Congressional Budget Office, *Costs of Implementing Recommendations of the 2019 Missile Defense Review* (Washington, DC: Congressional Budget Office, January 2021), 20–23, https://www.cbo.gov/system/files/2021-01/56949-MissileDefenseReview.pdf.

Though India is certainly proximate to missile launch sites, Pakistani missiles have extremely short burnout times, compressing the timeline for ISR tracking, launch, and kill. Dean Wilkening estimates that theatre-range missiles burn out between 60 and 150 seconds.[6] An earlier study approximates that missiles with a range of 600 to 2,000 km have a burnout time of about 60 seconds.[7] The same study calculates that space-based sensors detect missiles 30 to 60 seconds after launch, and that land-based radars do so approximately 90 to 120 seconds after launch.[8] Airborne radars might detect the launch in 15 seconds, but this is predicated on them being 400 km away.[9]

Operating airborne radar and interceptors 400 km from Pakistani launch points would leave the platform vulnerable to Pakistan surface-to-air missiles (SAMs) and fighter aircraft. The Indian air force currently has 31 squadrons instead of the 42 required and is only expected to have 35 by the mid-2030s.[10] Notwithstanding the costs of numerous airborne radars along the roughly 3,000 km border, air defense would require a massive increase in fighter squadrons, stressing an already underequipped military.

The timelines for space-based sensors and land-based radars paint a bleaker picture. Pakistan's missiles have burnout times of between 60 and 160 seconds (likely shorter, since they are solid fueled). Sensors that detect a missile launch between 30 and 60 seconds would leave between 30 and 120 seconds in which to confirm, track, launch, and intercept. This would be a momentous undertaking considering the number of missiles India has to track and the fact that these are best-case estimates. India also lacks experience developing the fast-accelerating interceptors required for boost-phase defense.

Even if India overcomes these challenges, Pakistan can employ relatively easy workarounds. Pakistan's missiles are mostly road-mobile; its road network is densest closer to the Indian border, and other regions such as Balochistan and Khyber Pakhtunkhwa are beset with internal security problems.[11] Therefore, a significant number of Pakistan's missiles would be launched from close to the Indian border, likely only needing to travel between 200 and 300 km.[12] Because boost-phase intercepts target missile boosters, the reentry vehicles continue on ballistic trajectories and land short of the target. Despite successful interception, warheads can still detonate over Indian territory—just not at the intended targets. The number of population centers near the border with Pakistan ensures this would be an unacceptable outcome for India.

To conclude, it is near-impossible for boost-phase missile defense to prevent nuclear detonations over Indian territory. Even if breakthroughs are made in technology that enables near instantaneous boost-phase intercepts, such technology would be prohibitively expensive to develop. India's

6 Dean A. Wilkening, "Airborne Boost-Phase Ballistic Missile Defense," *Science and Global Security* 12, no. 1 (2004): 30, https://doi.org/10.1080/08929880490464649.

7 M. V. Ramana, R. Rajaraman, and Zia Mian, "Nuclear Early Warning in South Asia: Problems and Issues," *Economic and Political Weekly* 39, no. 3 (2004): 279, https://www.jstor.org/stable/4414527.

8 Ibid.

9 Wilkening, "Airborne Boost-Phase Ballistic Missile Defense," 7.

10 Dinakar Peri, "India's Fighter Jet Conundrum," *The Hindu*, April 20, 2023, https://www.thehindu.com/news/national/indias-fighter-jet-conundrum/article66761396.ece.

11 "Pakistan Road Network (Main Roads)," WFP GeoNode, https://geonode.wfp.org/layers/ogcserver.gis.wfp.org%3Ageonode%3Apak_trs_roads_osm.

12 Hans M. Kristensen, "Pakistan's Evolving Nuclear Weapons Infrastructure," Federation of American Scientists, November 16, 2016, https://fas.org/publication/pakistan-nuclear-infrastructure/.

attempts at national missile defense would hence focus only on midcourse and terminal-phase intercepts. The next section details the methodology used to examine these scenarios.

METHODOLOGY

This paper uses rough cost estimates of different U.S. missile systems because of the lack of information available about Indian missile systems. After comparing costs of various U.S. missile defense systems, the paper uses $15 million as a notional cost per missile interceptor.[13] This averages research, production, operating, and maintenance costs of the interceptors, associated sensors and radars, launch platforms, and support systems into a single number. The same estimated cost is used for midcourse and terminal-phase interceptors.

Interceptor costs for India are likely to be higher than for the United States. The latter has conducted research on associated technology for decades, with resulting institutional knowledge. India has not; developing the technology required for large-scale, high-probability missile interceptions from scratch would hence be more expensive for India. India's domestic defense production also does not have the same economies of scale. Therefore, it is almost certain that the cost per missile will not be less than $15 million. The figures show that even in the hypothetical event that per-interceptor costs are $15 million, India lacks the resources to deploy these systems at scale. Accurate accounting with India-specific data would drive cost estimates even higher.

For each of the scenarios considered below, the paper considers two different interceptor parameters as bookends. In the best-case scenario, India develops an interceptor with a single shot probability of kill (SSPK) of 0.7 and requires 0.8 as the probability of zero leakers—meaning no missile penetrates the defense system. In the worst-case scenario, India develops an interceptor with SSPK 0.5, requiring a probability of zero leakers of 0.9. These figures have been chosen to show the minimum and maximum number of interceptors required per scenario. All calculations come from a reference sheet created by David Mosher for exploring missile defense layers and interceptor numbers, relying on studies by Dean Wilkening.[14]

MIDCOURSE INTERCEPT ONLY

India demonstrated midcourse intercept capabilities with its anti-satellite (ASAT) test in 2019.[15] Its Prithvi Defense Vehicle is meant for midcourse intercepts, and the S-400 40N6 may have exo-atmospheric intercept capability.[16] An earlier study concluded that missile flight times between Pakistan and India range from 8 minutes (~600 km) to 13 minutes (2,000 km).[17] A depressed-trajectory flight ranging 600 km (with several major Indian cities in range, including New Delhi)

13 Tyler Rogoway and Joseph Trevithick, "Here Is What Each Of The Navy's Ship-Launched Missiles Actually Costs," The Drive, December 11, 2020, https://www.thedrive.com/the-war-zone/38102/here-is-what-each-of-the-navys-ship-launched-missiles-actually-costs; and Yashwant Raj, "US Offers to Sell THAAD Defence System to India as Alternative to Russian S-400s," *Hindustan Times*, May 12, 2019, https://www.hindustantimes.com/india-news/us-proposes-to-sell-thaad-to-india-as-alternative-to-russian-s-400s/story-EqzAqK47PkfXxw1Cl1NGDJ.html.

14 Dean A. Wilkening, "A Simple Model for Calculating Ballistic Missile Defense Effectiveness," Stanford Center for International Security and Arms Control, August 1998, https://www.files.ethz.ch/isn/22265/17_Simple_Model_Calculating_Effectiveness.pdf.

15 Ashley Tellis, "India's ASAT Test: An Incomplete Success," Carnegie Endowment for International Peace, April 15, 2019, https://carnegieendowment.org/2019/04/15/india-s-asat-test-incomplete-success-pub-78884.

16 Franz-Stefan Gady, "India Successfully Tests Prithvi Defense Vehicle, A New Missile Killer System," *The Diplomat*, February 15, 2017, https://thediplomat.com/2017/02/india-successfully-tests-prithvi-defense-vehicle-a-new-missile-killer-system/.

17 Ramana, Rajaraman, and Mian, "Nuclear Early Warning in South Asia."

would take merely 5 minutes. Approximate midcourse flight times would hence range 6 to 11 minutes, and possibly as little as 3 minutes for depressed-trajectory flights.[18] Theoretically, shorter flight times would make detection easier because warheads and boost vehicles have less time to cool in space. However, it does not solve the problem of distinguishing warheads from penetration aids. If India does pursue midcourse defense at scale, it would be relatively trivial for Pakistan to develop decoys to defeat Indian defenses.[19]

The table below considers the number of interceptors required for different scenarios against Pakistan. The paper assumes that India will only get one shot at a midcourse intercept because of the flight times involved, which are too short for a shoot-look-shoot approach.[20] The analysis hence calculates the number of interceptors as a barrage being fired, increasing the number of interceptors involved.[21] The analysis also considers scenarios in which Pakistan develops penetration aids indistinguishable from the warheads. Such aids would be relatively easy to develop and would still require tracking and targeting by India.

Table 2: Notional Costs for Indian Midcourse Defenses

Number of Warheads	SSPK	(P) Zero Leakers	Number of Interceptors *(Warheads Only)*	Cost of Warheads Only *(USD, billions)*	Interceptors *(Warheads + 1 PenAid)*	Cost of Warheads + 1 *(USD, billions)*	Interceptors *(Warhead + 2 PenAids)*	Cost of Warheads + 2 *(USD, billions)*
20	0.7	0.8	80	1.2	200	3	300	4.5
	0.5	0.9	160	2.4	360	5.4	600	9
40	0.7	0.8	200	3	400	6	720	10.8
	0.5	0.9	360	5.4	800	12	1,320	19.8
60	0.7	0.8	300	4.5	720	10.8	1,440	21.6
	0.5	0.9	600	9	1,320	19.8	2,880	43.2

Source: The methodology to calculate interceptor numbers taken from Dean A. Wilkening, "A Simple Model for Calculating Ballistic Missile Defense Effectiveness," Stanford Center for International Security and Arms Control, August 1998, https://www.files.ethz.ch/isn/22265/17_Simple_Model_Calculating_Effectiveness.pdf. Calculations conducted in a reference sheet created by David Mosher.

Pakistan currently has an estimated 165 warheads; if India truly wanted to develop national missile defense, preparing to intercept 60 warheads with at least two penetration aids each is not an unrealistic requirement.[22]

TERMINAL-PHASE INTERCEPT ONLY

India's current missile defense program has elements of a terminal system designed around two tiers. The Prithvi Air Defense is for exo-atmospheric intercepts (of limited midcourse capability), and

18 Ibid., 281.
19 Andrew M. Sessler et al., *Countermeasures: A Technical Evaluation of the Effectiveness of the Planned US National Missile Defense System* (Cambridge, UK: Union of Concerned Scientists, Massachusetts Institute of Technology, April 2000), https://www.ucsusa.org/sites/default/files/2019-09/countermeasures.pdf.
20 Shoot-look-shoot implies that additional interceptor missiles are fired only after confirmation of success/failure by an earlier interceptor missile. This makes missile defense more efficient and cost effective.
21 Wilkening, "A Simple Model for Calculating Ballistic Missile Defense Effectiveness."
22 Hans M. Kristensen and Matt Korda, "Pakistan Nuclear Weapons 2021," *Bulletin of the Atomic Scientists* 77, no. 5 (September 2021): 265–78, https://doi.org/10.1080/00963402.2021.1964258..

Advanced Air Defense is for endo-atmospheric intercepts. Recent tests suggest that India may be developing the second phase of these systems.[23] However, terminal defense systems have limited intercept ranges and can only be used for point defense rather than wide-area defense. India has nine cities with a population of more than 3 million, around 50 cities with a population of more than 1 million, and around 100 cities with a population of more than 500,000.[24] Should Pakistan consider countervalue strikes, India represents a target-rich environment, especially given the large number of cities proximate to the border.

The table below considers some scenarios that may not be valid; for instance, systems for New Delhi and Mumbai may prepare to intercept at least 30 warheads, if not more. Smaller cities, however, will likely lack such extensive coverage. Similarly, the table does not account for any penetration aids or decoys that Pakistan may deploy. However, the range of costs, even for as few as 10 warheads, illustrates the high cost of nation-wide terminal defenses.

Table 3: Notional Costs for Indian Terminal-Phase Defenses

Number of Warheads	SSPK	(P) Zero Leakers	Number of Interceptors for One Site	Cost for One Site *(USD, billions)*	Cost for 30 Sites *(USD, billions)*	Cost for 60 Sites *(USD, billions)*
10	0.7	0.8	40	0.6	18	36
	0.5	0.9	70	1.05	31.5	63
20	0.7	0.8	80	1.2	36	72
	0.5	0.9	160	2.4	72	144
30	0.7	0.8	150	2.25	67.5	135
	0.5	0.9	270	4.05	121.5	243

Source: The methodology to calculate interceptor numbers taken from Wilkening, "A Simple Model for Calculating Ballistic Missile Defense Effectiveness"; and calculations conducted in a reference sheet created by David Mosher.

COUNTERFORCE PLUS TWO-LAYER MISSILE DEFENSE (MIDCOURSE PLUS TERMINAL)

Some scholarship has suggested that India may be developing counterforce capabilities to allow a splendid first strike against Pakistan.[25] Others point out that this is highly unlikely.[26] However, this scenario bears exploring, since it is where perceptions of Pakistani decisionmakers could be most skewed. Pakistan's limited geographical depth, relatively small number of nuclear warheads, de-mating of weapons during peacetime, and high number of "soft" targets all contribute to survivability concerns in Pakistan. Soft targets here refer to Pakistan's lack of hardened silos; its road-mobile missiles, if located, are relatively easy to destroy. As noted, Pakistan's road network is densest next to the Indian border, increasing fears of detection and pre-emptive strikes.

Therefore, Pakistani policymakers might seriously consider scenarios in which India conducts pre-emptive counterforce operations to destroy most of Pakistan's arsenal and a competent missile defense

23 "India Conducts Maiden Test Of AD-1 Ballistic Missile Interceptor," Overt Defense, November 3, 2022, https://www.overtdefense.com/2022/11/03/india-conducts-maiden-test-of-ad-1-ballistic-missile-interceptor/.
24 "Population of Cities in India 2022," World Population Review, https://worldpopulationreview.com/countries/cities/india.
25 Clary and Narang, "India's Counterforce Temptations."
26 Rajesh Rajagopalan, "India and Counterforce: A Question of Evidence," Observer Research Foundation, May 2020, https://www.orfonline.org/wp-content/uploads/2020/05/ORF_Occasional_Paper_247_India-Counterforce.pdf.

is used to "mop up" the remaining warheads Pakistan would fire at India. The table below proposes illustrative costs for a multilayered missile defense system to study India's ability to field a stronger missile shield. It supposes a two-layered system, the first layer being midcourse interceptors, and the second layer being terminal interceptors. India would be unaware of which Pakistani nuclear weapons it failed to destroy in a first strike. Preparations for national missile defense imply terminal-phase defenses everywhere to prepare for uncertainty. Similarly, the number of midcourse and terminal interceptors required increases if penetration aids are indistinguishable from warheads. This paper assumes that the terminal phase is too short to tell decoys apart from warheads, and penetration aids would be targeted as well for safety's sake. Additionally, it is not difficult for Pakistan to develop penetration aids similar in shape and weight to its warheads to prevent discrimination in the terminal phase; it saves Pakistan valuable fissile material even as it adds unnecessary weight to the payload.

Table 4: Notional Costs for a Multilayered Missile Defense

Number of Warheads	SSPK	(P) Zero Leakers	Interceptors First Layer	Interceptors Second Layer *(Terminal)*	Total Interceptors for 10 Terminal Sites	Total Interceptors for 30 Terminal Sites	Cost for 10 Terminal Sites *(USD, billions)*	Cost for 30 Terminal Sites *(USD, billions)*
20	0.7	0.8	20	18	200	560	3	8.4
	0.5	0.9	40	30	340	940	5.1	14.1
20 *(+1 aid each)*	0.7	0.8	40	48	520	1,480	7.8	22.2
	0.5	0.9	80	70	780	2,180	11.7	32.7
40	0.7	0.8	40	48	520	1,480	7.8	22.2
	0.5	0.9	80	70	780	2,180	11.7	32.7
40 *(+1 pen aid)*	0.7	0.8	80	96	1,040	2,960	15.6	44.4
	0.5	0.9	240	70	940	2,340	14.1	35.1

Source: The methodology to calculate interceptor numbers taken from Wilkening, "A Simple Model for Calculating Ballistic Missile Defense Effectiveness"; and calculations conducted in a reference sheet created by David Mosher.

It is a realistic assumption that 40 warheads would be left after India's attempted first strike, and this would probably be a worst-case scenario which India would hedge against. Ten terminal sites in a two-layered system are more realistic than 30 but could still cost anywhere between $3 billion and $15.6 billion (keeping in mind the very low estimate of $15 million per interceptor). Therefore, a multi-layered system that could competently threaten Pakistan's nuclear deterrent would be far beyond India's resources.

SUMMARY

Table 5: Summary of Estimates

Scenario	Number of Warheads	Description	SSPK	(P) Zero Leakers	Number of Interceptors	Cost *(USD, billions)*
Midcourse	20	No pen aids	0.7	0.8	80	1.2
	60	Two pen aids each	0.5	0.9	2,880	43.2
Terminal Phase	10	One site only	0.7	0.8	40	0.6
	20	Thirty sites	0.7	0.8	80	36
	30	Sixty sites	0.5	0.9	270	243
Counterforce + Two-Layer Defense	20	No pen aids, 10 terminal sites	0.7	0.8	200	3
	40	One pen aid each, 30 terminal sites	0.5	0.9	2,340	35.1

Source: The methodology to calculate interceptor numbers taken from Wilkening, "A Simple Model for Calculating Ballistic Missile Defense Effectiveness"; and calculations conducted in a reference sheet created by David Mosher.

India has a small stockpile of fissile material and produces relatively small amounts annually. As a result, nuclear-armed interceptors to improve SSPK and reduce the number of interceptors required are not practical.[27] India's 2021 defense budget set aside $18.5 billion for all weapons procurement, and less than $2 billion for research and development.[28] Developing national missile defense, even over several years, would far exceed the resources India has to spare for defense. Developing a limited national missile defense against a very small number of warheads would serve no purpose and merely prompt destabilizing Pakistani behavior without the ability to guard against said behavior. The third scenario (counterforce plus layered missile defense) also does not account for the significant resources counterforce capabilities require.

In the unlikely event that India develops national missile defense after reducing costs by orders of magnitude, Pakistan can adopt numerous inexpensive workarounds. It already fields an estimated 12 nuclear-tipped ground-launched cruise missiles and is in the process of fielding nuclear-tipped cruise missiles on advanced conventional submarines.[29] Developing defenses against these missiles would be as expensive as ballistic missile defense, if not more. Similarly, an expansive midcourse defense can be made ineffective or impractical by increasing the number of relatively cheap, sophisticated penetration aids.

Though the results of this paper are contingent on various assumptions, most are unlikely to be challenged. There is one exception: India developing counterforce capabilities concurrent with a breakthrough in midcourse detection and discrimination would make national missile defense much more feasible. It would still be an expensive undertaking but would prompt destabilizing behavior merely because of the perception of successful national missile defense. Failing this, the current

27 Hans M. Kristensen and Matt Korda, "Indian Nuclear Forces, 2020," *Bulletin of the Atomic Scientists* 76, no. 4 (2020): 217–25, https://doi.org/10.1080/00963402.2020.1778378.

28 Vivek Raghuvanshi, "India Releases Details of New Defense Budget," Defense News, February 2, 2021, https://www.defensenews.com/global/asia-pacific/2021/02/02/india-releases-details-of-new-defense-budget/.

29 Kristensen and Korda, "Pakistan Nuclear Weapons 2021"; and H. I. Sutton, "Pakistan's New Type-039B AIP Submarines," Naval News, October 6, 2020, https://www.navalnews.com/naval-news/2020/10/pakistans-new-chinese-aip-submarines-image-shows-karachi-site/.

trajectory of missile defense seems likely—terminal defense for key sites such as New Delhi and Mumbai to prevent decapitation attacks. The large number of other targets available to Pakistan ensures nuclear deterrence is maintained. Even if India decides (unwisely) to pursue such national missile defense capabilities, it lacks the resources to field a workable missile shield. Consequently, current Indian missile defense, and most prospective developments over the next 15 to 20 years, are not destabilizing for the India-Pakistan nuclear dyad. In fact, Chinese missile defense and its destabilizing impact on the China-India dyad is an important area of research; India's low number of high-yield warheads exacerbates the impact of Chinese mid-course interceptors.[30]

IMPLICATIONS

India's Cold Start doctrine is infamously quoted as the impetus for Pakistan's short-range missile systems (~60 km).[31] These missiles lower the threshold for nuclear use, notwithstanding the resulting command and control (C2) challenges. However, some work points out that Pakistan's conventional deterrence is better than expected, and that even a quick, limited-war doctrine such as Cold Start is unlikely to meet India's objectives.[32] To be clear, this does not imply conventional parity between the two militaries. Rather, it emphasizes that workarounds to counter Pakistan's asymmetric nuclear deterrence did not meet their objectives but still prompted destabilizing behavior.

If Indian missile defense is impossible to the point of degrading Pakistan's second-strike capabilities, what is prompting Pakistan's nuclear modernization? Its new submarine-launched cruise missile is aimed at an "emerging regional BMD [ballistic missile defense] environment," despite the monumental operational and C2 challenges.[33] These submarines can only be fielded from Karachi and Ormara, making it relatively easier for India to track deployed submarines. When considered with the range of the missile (450 km), this creates new survivability concerns for the submarines, rather than mitigating misplaced survivability concerns for missiles.

These two examples question conventional wisdom about the drivers of Pakistan's nuclear posture. Is there an analytical or perceptual gap, where Pakistani leaders actively worry about limited war, counterforce, or Indian missile defense? Are the stated concerns just easy rhetoric to justify capability development? Recent literature has covered the bureaucratic and organizational drivers of Pakistan's nuclear posture, but only until 1998.[34]

In 2023, what is Pakistan modernizing for, and what is it hedging against? These are important questions to consider as India modernizes its own military with China in mind. A skewed understanding of Pakistan's threat perceptions could see India unwittingly develop capabilities that destabilize the nuclear relationship between the two. Alternatively, understanding what influences Pakistani posture could allow India to pursue capabilities that assuage risk. Both scenarios warrant a closer study of influences on Pakistan's nuclear forces.

30 Ashley J. Tellis, *Striking Asymmetries: Nuclear Transitions in Southern Asian* (Washington, DC: Carnegie Endowment for International Peace, 2022), chap. 4, https://carnegieendowment.org/2022/07/18/striking-asymmetries-nuclear-transitions-in-southern-asia-pub-87394.

31 Sitara Noor, "Did Pakistan Just Overhaul Its Nuclear Doctrine?," *Foreign Policy*, June 19, 2023, https://foreignpolicy.com/2023/06/19/pakistan-india-nuclear-weapons-zero-range-cold-start-doctrine/.

32 Walter C. Ladwig III, "Indian Military Modernization and Conventional Deterrence in South Asia," *Journal of Strategic Studies* 38, no. 5 (2015): 729–72, https://doi.org/10.1080/01402390.2015.1014473.

33 Kristensen and Korda, "Pakistan Nuclear Weapons 2021."

34 Mansoor Ahmed, *Pakistan's Pathway to the Bomb* (Washington, DC: Georgetown University Press, 2022).

Russia's Dwindling Nonnuclear Strategic Arsenal

The Impact of Russia's Invasion of Ukraine on Russian Nuclear Escalation Management Strategy

By Caleb Yip[1]

INTRODUCTION

Russia's full-scale invasion of Ukraine brought the country's revisionist ambitions into sharp relief while also exposing the severe shortcomings of the Russian military. Russia's poor performance in Ukraine holds many lessons for conventional force planners, but the impacts of Moscow's battlefield failures on Russian nuclear strategy and escalation management have not yet been well studied. Though most analysts do not believe Russia will use nuclear weapons on the battlefield, the Kremlin's frequent nuclear saber-rattling has worried policymakers. At the same time, Moscow has expended large numbers of precision guided munitions (PGMs), even as its defense industrial base faces sanctions and economic constraints that make it unlikely to be able to replace those munitions at scale. All of these factors raise serious questions of how Moscow may approach escalation management in a regional conflict between Russia and NATO forces, especially since Russian nuclear strategy appears to rely heavily on nonnuclear strategic weapons such as conventional PGMs.

This analysis explores how Russia's strategy for nuclear escalation management has been impacted by Russia's war in Ukraine and its dwindling strategic conventional arsenal; it then provides

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recommendations about how the United States and its allies should respond to a revisionist but weakened Russia that must increasingly rely on its nuclear stockpile. In the post–Cold War era, Russia's strategic doctrine has evolved to incorporate strategic conventional weapons into its nuclear strategy through the idea of nonnuclear deterrence, leading to a doctrinal reliance on conventional PGMs as a prelude to nuclear use. However, Russia's full-scale invasion of Ukraine has demonstrated significant technical faults with these weapons, even as Western sanctions have severely weakened the Russian defense industrial base's ability to produce these weapons. As a result, Russia is likely to return to a lowered nuclear threshold and rely more heavily on nonstrategic nuclear weapons (NSNW) and the psychological effects of NSNW threats to deter aggression. Importantly, U.S. and allied policymakers must remember that while Russia may lower its nuclear threshold, such a threshold is not necessarily one with which Russian strategists are comfortable. Improved missile defenses and continued support for Ukraine can also force Russia to confront greater ambiguity about the likelihood that aggression can succeed. Concurrently, the United States will need to explore paths to encourage Russian restraint by addressing Russian threat perceptions without compromising U.S. or allied interests.

UNDERSTANDING RUSSIAN NUCLEAR ESCALATION MANAGEMENT

Nuclear escalation refers to the process of moving from conventional to nuclear weapons in a large-scale conflict. Relatedly, escalation management can be understood as actions that seek to "dissuade, intimidate, or achieve de-escalation at key transition points and early phases of conflict" by raising the adversary's expected costs well above the desired benefits while reducing the risks of large-scale global or thermonuclear war.[2] Russian strategists see escalation management as a continuous process that spans peacetime and wartime and view nuclear and nonnuclear capabilities as critical tools to de-escalate a conflict in a favorable manner. Importantly, escalation management should be understood within the higher-order priority of avoiding defeat—Russian nuclear strategy allows policymakers the flexibility to use nuclear and nonnuclear tools in tandem to achieve deterrence or, if necessary, to fight and defeat adversaries. Russian doctrine and strategy documents indicate that Russian analysts divide their military into general purpose forces and strategic deterrence forces, assigning the intrawar deterrence mission to the latter. Intrawar deterrence is based on what Russian strategists term "fear-inducement" (устраншение) and progressive damage infliction through the application of "deterrent damage" (сдерживающий ущерб).[3]

Fear inducement advances deterrence by demonstrating Russia's capability and willingness to inflict progressively greater damage on an adversary's critically important targets to convince an adversary that the costs of further aggression outweigh the potential gains. Fear inducement is operationalized through single or grouped (low-yield nuclear or nonnuclear) strikes delivering calculated, or "assigned," damage against high-value targets, with the implicit threat of more to come.[4] These strikes deliver deterrent damage, which is broadly understood to be the damage that

2 Michael Kofman and Anya Loukianova Fink, "Escalation Management and Nuclear Employment in Russian Military Strategy," War on the Rocks, September 19, 2022, https://warontherocks.com/2022/09/escalation-management-and-nuclear-employment-in-russian-military-strategy-2/.

3 Michael Kofman, Anya Fink, and Jeffrey Edmonds, *Russian Strategy for Escalation Management: Evolution of Key Concepts* (Arlington, VA: Center for Naval Analyses, April 2020), 8, https://www.cna.org/reports/2020/04/DRM-2019-U-022455-1Rev.pdf.

4 Ibid., ii.

Russia inflicts on civilian and military targets to manage escalation and communicate resolve. The targets are militarily useful to the adversary with low to no collateral damage, which limits the risks of unintended escalation caused by large-scale civilian casualties while setting favorable conditions for continued warfighting and the defeat of Russia's adversaries. Russian strategists envision these strikes as an iterative process of dosed damage that can communicate Russian resolve while also favorably altering the military balance. NSNWs play a large role in this phase of war because Russian strategists believe that they can be more credibly threatened or used with lower risks of escalating to strategic nuclear exchanges.

EMERGENCE OF NONNUCLEAR DETERRENCE AND STRATEGIC CONVENTIONAL WEAPONS IN DOCTRINE

Both Russia and the United States have long viewed strategic conventional weapons such as PGMs as complementary to nuclear weapons in strategic deterrence. Nonnuclear (also referred to as pre-nuclear) deterrence was first considered by Soviet strategists confronted by what they termed the United States' "reconnaissance-strike complex."[5] U.S. employment of PGMs in Bosnia and Iraq showed that precision could make conventional weapons strategic and hinted at the possibility of sustained conventional wars without nuclear use.[6] In the 1990s and 2000s, Russian analysts saw these new nonnuclear capabilities as both militarily usable and strategically significant, which allowed Russia to narrow the gap between general purpose forces and nuclear use.[7] Nonnuclear deterrence officially entered Russian military doctrine in 2014, and as Russia's nonnuclear strategic capabilities matured, so did its deterrence thinking. Russian strategists believed these capabilities performed the fear inducement mission equally or more effectively than NSNWs. In addition to demonstrating Russia's ability to inflict deterrent damage, conventional strategic weapons also lend coercive credibility to threats of follow-on nuclear strikes by demonstrating a willingness to use force. This made conventional strategic weapons an attractive tool, as they allowed Russia the flexibility to raise its nuclear threshold, and Russian nuclear doctrine reflected this trend. Senior officials such as Minister of Defence Sergei Shoigu noted how strategic conventional weapons allowed for "the role of nuclear weapons in deterring a potential aggressor [to] diminish."[8] Essentially, these nonnuclear capabilities added more rungs to the escalation ladder and gave Russia more flexibility to execute a sustained conventional war.

Conventional strategic weapons are also the ideal tools to inflict damage on an adversary because of their psychological effects. By the end of the Cold War, Russian strategists had moved away from an objective "unacceptable damage" criteria, which involved threatening catastrophic damage to an adversary's population and industrial base, to the more subjective concept of deterrent damage when evaluating Russian strategic deterrence.[9] Recent Russian writings have suggested that deterrence could be perception-based, and that actual damage may be secondary to how that damage is perceived, which is more in line with Western thinking of how deterrence is perceived

5 Roger N. McDermott and Tor Bukkvoll, *Russia in the Precision-Strike Regime: Military Theory, Procurement, and Operational Impact* (Oslo: Norwegian Defence Research Establishment, August 2017), 9, https://ffi-publikasjoner.archive.knowledgearc.net/bitstream/handle/20.500.12242/1291/17-00979.pdf.

6 Kofman, Fink, and Edmonds, *Russian Strategy for Escalation Management*, 53.

7 Kristin Ven Bruusgaard, "Russian Nuclear Strategy and Conventional Inferiority," *Journal of Strategic Studies* 44, no. 1 (2021): 23, https://doi.org/10.1080/01402390.2020.1818070.

8 Ibid., 26.

9 Kofman, Fink, and Edmonds, *Russian Strategy for Escalation Management*, 30.

by an adversary.[10] This approach is primarily targeted at decisionmakers and involves convincing an adversary's political-military leadership of the catastrophic consequences of further aggression. Russian analysts conceptualize this process via the "Strategic Operation for the Defeat of Critically Important Targets" (стратегическая операция по поражению критически важных объектов), or SODCIT, which is the scalable mechanism by which Russia delivers damage to key targets of military and military-economic potential.[11] A critical component of SODCIT is the ability to inflict militarily useful damage while reducing the likelihood of unintentional escalation or strengthening the adversary's political resolve by causing excessive civilian casualties. Strategic conventional weapons are far better suited for this task than low-yield nuclear weapons, as conventional weapons can destroy critical targets in close proximity to civilian populations without risking significant collateral damage, which make them ideal for escalation management. Their utility is further enhanced by the fact that many Russian strategic conventional systems are dual-capable, which strengthens the credibility of follow-on nuclear strikes from those same platforms. Overall, Russian strategists have embraced the flexibility offered by strategic conventional weapons, with then prime minister Vladimir Putin remarking that they "are comparable to employment of nuclear weapons in results but more 'acceptable' in political and military terms."[12] As a result of their usability in the early stages of a conflict and their ability to fulfill many of the missions formerly assigned to NSNWs, strategic conventional weapons have become a critical component of Russian strategic deterrence.

THE WAR IN UKRAINE AND RUSSIA'S DWINDLING NONNUCLEAR STRATEGIC STOCKPILE

Russia's full-scale invasion of Ukraine has both exposed the limitations of its strategic conventional weapons and significantly diminished its stockpiles. In March 2022, the Department of Defense (DOD) confirmed that Russian missiles were experiencing high failure rates of 20 to 60 percent, and reports also indicate that some missiles failed to explode upon striking their targets.[13] This suggests a level of quality and reliability that is incompatible with the ability to precisely strike targets. In addition, analysts have observed accuracy problems with Russian missiles. Russian military journalists have ascribed a circular error probable of up to 30 meters for the Kalibr sea-launched cruise missile and between 5 and 50 meters for the Kh-101 air-launched cruise missile, significantly higher than the Russian Ministry of Defence's claim of "just a few meters."[14]

Partly as a result of accuracy and reliability problems, Moscow has quickly used up its stockpile of conventional strategic weapons. The DOD reported in May 2022 that Russia had used more than 2,125 ballistic and cruise missiles, leaving the country with approximately 50 percent of its prewar stockpile.[15] Russia has been unable to quickly replenish its stockpiles and has resorted to using

10 Dave Johnson, *Russia's Conventional Precision Strike Capabilities, Regional Crises, and Nuclear Thresholds* (Livermore, CA: Lawrence Livermore National Laboratory, Center for Global Security Research, February 2018), 43, https://cgsr.llnl.gov/content/assets/docs/Precision-Strike-Capabilities-report-v3-7.pdf.

11 Timothy L. Thomas, *Russian Military Thought: Concepts and Elements* (McClean, VA: MITRE, August 2019), https://www.mitre.org/sites/default/files/2021-11/prs-19-1004-russian-military-thought-concepts-elements.pdf.

12 Johnson, *Russia's Conventional Precision Strike Capabilities*, 46.

13 Mark B. Schneider, "Lessons from Russian Missile Performance in Ukraine," U.S. Naval Institute, *Proceedings* 148, no. 10 (October 2022), https://www.usni.org/magazines/proceedings/2022/october/lessons-russian-missile-performance-ukraine.

14 Igor Rozin, "Russia's most devastating sea, ground, and air missiles," Russia Beyond, November 7, 2017, https://www.rbth.com/science-and-tech/326642-russias-most-devastating-sea-ground.

15 John Ismay, "Russian Guided Weapons Miss the Mark, U.S. Defense Officials Say," *New York Times*, May 9, 2022, https://www.nytimes.com/2022/05/09/us/politics/russia-air-force-ukraine.html; and "Top official explains why Russia hasn't run out of precision missiles in Ukraine," RT, April 19, 2022, https://www.rt.com/russia/554134-borisov-interview-defense-industry/.

inaccurate, Soviet-era missiles and crude Iranian drones, neither of which can replace precision weapons.[16] For example, the Shahed-136 drones employed by Russian forces carry an explosive payload of 118 pounds, which cannot damage or destroy most hardened military targets.[17] With shortages and systemic accuracy problems plaguing Russia's PGM arsenal, it is hard to imagine that Moscow will be able to reliably use conventional strategic weapons against NATO forces according to its doctrine. In order to iteratively apply damage and demonstrate resolve, Russian doctrine envisions precisely targeted strikes against critical targets, a mission set that Russia has struggled with against the far weaker Ukrainian military.

Another factor that exacerbates Russia's problems with nonnuclear deterrence is the inability of the Russian defense industrial base to keep production apace with demand, which will likely be enduring as Western sanctions constrict Moscow's access to advanced components. Almost every Russian weapon system, including all of its conventional cruise and ballistic missiles, requires specialized Western semiconductors.[18] In fact, the Russian National Academy of Science concluded in 2022 that many critical parts simply cannot be made in Russia.[19] While Moscow can still illegally source these components via states sympathetic to its interests, it cannot do so at a scale that would support the production rates needed to quickly replenish its stockpiles or to keep pace with what is likely to be a highly intense rate of use in a hypothetical conflict with NATO. Of course, it is important to recognize that Moscow retains a sizable stockpile of precision weapons, and it remains possible that Putin will formally put Russia's economy on a war footing and improve its ability to produce these munitions in the long term. Neither point, however, changes the fact that the Russian military remains highly dependent on Western-made components and will continue to struggle in rebuilding its stockpiles.

IMPLICATIONS FOR RUSSIAN NUCLEAR ESCALATION MANAGEMENT IN A CONFLICT WITH NATO

In sum, Russia's ill-fated invasion of Ukraine has shown that it will have real problems with escalation management as envisioned by its leadership. Fear inducement and the ability to apply iterative, dosed damage are at the center of Russia's nuclear escalation management strategy, but Moscow's preferred tool—conventional strategic weapons—has fallen short. High failure rates and accuracy problems mean that Russian planners cannot attack targets with the confidence that they will be struck or that collateral damage will be low. Meanwhile, the reduced number of missiles in Russia's inventory means that Russian forces will likely be unable to fight a sustained conventional war against NATO forces, which degrades Russia's ability to control escalation. If the United States and its allies are to continue deterring Russian aggression and prevent the use of nuclear weapons, it will be critical for policymakers to understand the broader implications of what Russia's lack of nonnuclear strategic weapons means for Moscow's nuclear escalation management strategy.

16 Kateryna Stepaneko et al., "Russian Offensive Campaign Assessment, January 14, 2023," Institute for the Study of War, January 14, 2023, https://www.understandingwar.org/backgrounder/russian-offensive-campaign-assessment-january-14-2023.

17 Dalton Bennett and Mary Ilyushina, "Inside the Russian effort to build 6,000 attack drones with Iran's help," *Washington Post*, August 17, 2023, https://www.washingtonpost.com/investigations/2023/08/17/russia-iran-drone-shahed-alabuga/.

18 Lydia Wachs, "The Role of Nuclear Weapons in Russia's Strategic Deterrence," *Stiftung Wissenschaft und Politik*, no. 68 (November 2022), 6, https://doi.org/10.18449/2022C68.

19 Jack Watling and Nick Reynolds, *Operation Z: The Death Throes of an Imperial Delusion* (London: Royal United Services Institute for Defence and Security Studies, April 2022), 14, https://static.rusi.org/special-report-202204-operation-z-web.pdf.

IMPACT ON RUSSIAN DOCTRINE

History indicates that when a nuclear weapon state loses confidence in its conventional forces, it will rely more heavily on its nuclear capabilities. Certainly, Russia has followed this trend, with leaders such as Putin and Dmitry Medvedev repeatedly engaging in nuclear saber-rattling and emphasizing Russia's nuclear forces. Should Russia choose to publish an updated strategic deterrence doctrine, it will likely place greater emphasis on nuclear weapons to overcome the shortcomings of its strategic conventional weapons. Moscow's ability to induce fear will also likely be reduced: while European allies remain vulnerable to massed cruise missile attacks against critical infrastructure, the missile strikes in Ukraine have demonstrated that such attacks would not be as devastating as European policymakers likely believed prior to the war. Neither Russia's early attempts to destroy Ukrainian air defenses and airfields nor its later campaign to target the Ukrainian energy grid has had a strategic effect on the war, and a similar effort against well-trained and well-equipped NATO forces is likely to be even less effective. Additionally, poor accuracy will force Russia to expend larger numbers of missiles on each target while making it easier for NATO to repair and recover after strikes, meaning that Moscow's threats of single or grouped strikes will be less militarily effective than envisioned.

The psychological impacts of Russian threats, however, are likely to be enhanced. One of the roles of conventional strategic weapons was to demonstrate Russian resolve to use force and implicitly threaten the escalation to nuclear weapons. As Russia will struggle to rebuild its stockpiles, that implicit threat of nuclear escalation is much more credible simply because, sooner or later, Russia will run out of missiles. When Russian forces can no longer fight with only conventional weapons, Moscow will be faced with the decision to escalate to nuclear weapons or risk defeat. In a conflict with NATO, where the stakes are potentially existential for the Kremlin, it is quite plausible that Russia will be forced to escalate to nuclear weapons, if only to fulfill a warfighting gap and avoid defeat. Russian analysts are undoubtedly aware of this logic and may attempt to enhance its coercive potential by emphasizing the ability for NSNWs to accomplish missions formerly assigned to conventional strategic weapons. Just as the early 2000s saw a doctrinal transition from relying on NSNWs to conventional weapons in the early stages of a conflict, so might Russia now transition back toward early use of NSNWs. Furthermore, the coercive potential of Russia's dual-capable systems is also likely to be enhanced: there is a higher likelihood that deployed Russian systems, such as an Iskander short-range ballistic missile, will contain nuclear warheads rather than conventional ones. As a result, such signaling measures will become more effective when U.S. and allied policymakers know that Moscow now has lower confidence in its conventional strategic weapons.

What is clear, however, is that Russia's ability to inflict iterative, dosed damage using PGMs is severely weakened and that Moscow will likely turn to alternative methods—including low-yield nuclear weapons—to fulfill the same role. Russia may turn to cyber or space-based assets to inflict damage, though the war in Ukraine is also demonstrating that a competent cyber defense can mitigate much of an attacker's advantage. Space-borne attacks also carry significant risks of their own. While space-based weapons could inflict significant damage on an adversary's critical targets, anti-satellite weapons risk creating large clouds of space debris that could disable Russia's own satellites. Likewise, attacking communications or early-warning satellites could trigger inadvertent escalation, which makes this prospect risky. While Russia certainly still has tools to inflict damage on an adversary, all of its alternatives to PGMs—whether it be low-yield nuclear weapons, anti-satellite weapons, cyberattacks, or other novel weapons—carry much greater risks of inadvertent escalation. Once Russia expends its stores of conventional PGMs, the overriding imperative of defeating its adversaries means that Moscow will need to decide whether to escalate to risky nuclear use in the

hopes of maintaining control of the situation, or accept its inability to adequately manage escalation and capitulate. In a conflict with NATO, Russian strategists have likely planned for widespread use of conventional PGMs to target NATO airbases and European ports to degrade sortie generation and the United States' ability to flow forces to Europe.[20] Without plentiful stores of precision munitions, Russia will find such a task difficult unless it escalates to other tools, including nuclear weapons.

IMPACT ON RUSSIAN DECISIONMAKING

Because Russian missiles are less militarily effective than decisionmakers had envisioned, the pre-conflict stages of a crisis may be more stabilizing, as conventionally inaccurate missiles raise the threshold for the use of force in the early stages of a conflict. During a time of military tension, but before general hostilities, Russian strategy calls for single strikes on critical targets to communicate Russian resolve while setting the stage for warfighting as needed. But if Russian decisionmakers are no longer confident that a single PGM can disable or even reach an intended target, they may need to use several missiles to accomplish the same mission. However, launching a salvo of missiles when conventional forces have not yet engaged the adversary may appear to be overly escalatory and undesirable from a conflict management perspective. As a result, Russian decisionmakers may find their threshold for the use of force to be higher than expected, which could provide more time in the early stages of a crisis for diplomatic off-ramps.

However, once hostilities are underway, this same logic creates greater instability by constraining the options for Russian decisionmakers. If Russian conventional units are failing, a lowered nuclear threshold will enhance the incentive to escalate to nuclear weapons and accelerate the time pressure on decisionmakers. Conventional strategic weapons allow for the possibility of a sustained conventional war, which means more time to recalibrate and seek off-ramps in a crisis. When sustained conventional war is no longer possible due to material shortages and technical faults, Russian leaders will be forced to make rapid decisions on whether to escalate or capitulate, making uncontrolled escalation more likely.

Of course, this logic can be coercively used by Moscow as well. An effective and diverse set of conventional strategic weapons gives Russian decisionmakers the flexibility to place the nuclear threshold at high or low levels, depending on the situation, and makes the use of nuclear weapons a political decision, rather than one driven by military necessity.[21] While the decision to use nuclear weapons likely remains a fundamentally political question, less reliable nonnuclear tools will impose constraints driven by warfighting needs. This reduces flexibility for Russian decisionmakers by imposing an as-yet-undetermined lowering of the nuclear threshold, which Russian strategists are already using to coerce the United States: a close adviser to Putin recently published an article concluding that Russia had "thoughtlessly set too high a threshold for the use of nuclear weapons" in its invasion of Ukraine.[22] Such language draws attention to the disproportionate stakes at play—a lowered Russian nuclear threshold may make the United States and its allies confront whether their vital interests are truly at stake, and U.S. policymakers would do well to ensure that they effectively communicate their resolve to Russia in a crisis.

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20 Christopher Yeaw et al., *The Challenge of Russia's Non-Strategic Nuclear Weapons* (Omaha, NE: National Strategic Research Institute, October 2021), 11, https://nsri.nebraska.edu/-/media/projects/nsri/docs/academic-publications/2021/october/the-challenge-of-russias-nsnw.pdf.

21 Johnson, *Russia's Conventional Precision Strike Capabilities*, 69.

22 Sergei A. Karaganov, "A Difficult but Necessary Decision," Russia in Global Affairs, June 13, 2023, https://eng.globalaffairs.ru/articles/a-difficult-but-necessary-decision/.

IMPACT ON RUSSIAN FORCE POSTURES

The forced reliance on NSNWs for strategic deterrence in the early 2000s spurred Russian investments into a host of alternative capabilities, including major investments into conventional PGMs. Russia's failure to replicate the precision revolution to the degree needed may in turn spur investments into alternatives, such as low-yield nuclear weapons. Very low-yield weapons, or nuclear weapons with yields of less than a kiloton, could conceivably perform the missions currently held by conventional PGMs: a 300-ton airburst weapon would cause significant structural damage in a relatively small 300-meter radius.[23] Since prompt radiation disperses quickly and an airburst will not create meaningful fallout, such small-yield weapons could become attractive alternatives for Russia. Of course, political considerations will continue to drive Russian nuclear decisionmaking, but from a military perspective, low-yield weapons are likely to become increasingly attractive.

POLICY IMPLICATIONS FOR THE UNITED STATES AND NATO

Russia's full-scale invasion of Ukraine has demonstrated the severe shortcomings of its conventional PGMs, which Moscow heavily relies on to execute its nuclear escalation management strategy. Russia's inability to reliably use conventional weapons to induce fear and inflict deterrent damage will likely lead to a renewed emphasis on its NSNWs, which will make any crisis between Russia and NATO more dangerous to navigate. In order to effectively ensure that any future crisis does not lead to nuclear use, the United States and its allies must first and foremost understand what the impacts of Russia's conventional failings are on its nuclear strategy. Going forward, policymakers should also keep the following in mind:

1. **Russia is not necessarily comfortable with a lowered nuclear threshold.**

   Although Putin has consistently raised nuclear weapons as a threat in the war, it is important for U.S. policymakers to remember that Russian strategists themselves are not necessarily comfortable with a lowered nuclear threshold. The last time that Russia was forced to rely on early nuclear use to deter conflict was during the 2000s, and during that period, there was a strong debate among analysts about whether such threats were credible, even in a regional war.[24] Before Russia's full-scale invasion of Ukraine, there was a vocal minority that called for early nuclear use, but the mainstream view among Russian strategists remained that nuclear threats or use were not very credible in the early stages of a conflict.[25] Of course, with Russia likely to lower its nuclear threshold due to conventional capability gaps, any future crisis would become more risky and prone to unintended escalation, and policymakers would do well to recognize these dangers. However, it is equally important that policymakers avoid self-deterrence—Moscow is likely to loudly trumpet its reliance on NSNWs to induce fear and communicate resolve, and the United States will need to respond firmly to reassure allies while avoiding escalation. Understanding the drivers behind Russian escalation management will help policymakers walk that fine line and confront the threat as it is, not as Moscow portrays it.

23 Alex Wellerstein, "NUKEMAP," Nuclear Secrecy, 2012, https://nuclearsecrecy.com/nukemap/.

24 Anya Fink and Michael Kofman, *Russian Strategy for Escalation Management: Key Debates and Players in Military Thought* (Arlington, VA: Center for Naval Analyses, April 2020), 15, https://www.cna.org/archive/CNA_Files/pdf/dim-2020-u-026101-final.pdf.

25 Ibid., 30.

2. **Missile defenses can further complicate Russia's calculus.**

   Missile defenses are a recurring topic in Russian writing, as theater missile defenses complicate Russia's escalation management strategy. Effective missile defenses deny Russia's ability to strike targets without committing large salvos of missiles, thus removing the lower forceful options available to Russia. Not only does that make the use of force less attractive from an escalation management perspective, but from a purely military perspective, missile defenses force Russia to expend scarce PGMs, thereby reducing Russia's overall strike capability.[26] Early employment of the Patriot anti-ballistic missile system in Ukraine has demonstrated that a layered air defense can intercept even highly advanced hypersonic missiles.[27] Going forward, NATO would do well to build up its theater missile defenses while also investing in emerging point-defense capabilities to protect airfields and other critical targets in a cost-effective manner.

3. **Encourage Russian restraint without impacting core U.S. or allied interests.**

   In determining its future force posture, the United States should bear in mind opportunities that can convince Russia that there are benefits to continued restraint. The United States should continue to signal its readiness to engage in strategic stability dialogues to reduce Russian threat perceptions. One such option may be to offer transparency mechanisms for Aegis Ashore sites that Russia believes could be used offensively. Reducing Russian anxieties on this and other sources of concern could aid in reducing Russia's perceived need to build up large NSNW stockpiles. Of course, policymakers must prioritize U.S. and allied defensive needs first, but it is certainly possible to do so while taking actions that address Russian threat perceptions.

4. **Ongoing efforts to support Ukraine are effective and should be reinforced.**

   The West's support for Ukraine has been highly effective and provides meaningful strategic benefits. The coordinated Western sanctions campaign is having significant impacts on Russia's defense industrial base and is limiting Russia's ability to replenish its conventional PGM stockpiles. Existing sanctions have forced Russia to resort to drastic measures, and the United States will need to proactively counter Moscow's illicit attempts to acquire Western-made components while ensuring that its allies and partners fully implement existing sanctions. Likewise, continued military aid to Ukraine attrits Russian conventional capabilities and ensures that Russia cannot return to prewar readiness levels in the near future. By arming Ukraine with the tools it needs on the battlefield, the United States ensures that Russia continues to bleed valuable munitions and scarce combat power, thereby cementing its enduring conventional advantage. The smaller the Russian arsenal, the less likely the Kremlin may be to use force in the early stages of a conflict, as Russian decisionmakers know that the escalatory pathways available to them are more unfavorable.

CONCLUSION

In sum, Russia's full-scale invasion of Ukraine has created real problems for its strategy of nonnuclear deterrence by demonstrating the unreliability of its conventional precision weapons while sharply

26 Anya Fink, "The Evolving Russian Concept of Strategic Deterrence: Risks and Responses," Arms Control Today, July/August 2017, https://www.armscontrol.org/act/2017-07/features/evolving-russian-concept-strategic-deterrence-risks-responses.

27 Victoria Kim and Eric Schmitt, "Ukraine Says It Shot Down Hypersonic Russian Missile Over Kyiv," *New York Times*, May 16, 2023, https://www.nytimes.com/2023/05/16/world/europe/ukraine-russia-hypersonic-kinzhal-patriot.html.

reducing its stockpiles. Going forward, Russia is likely to rely more heavily on its nuclear weapons, and Russian strategists are likely reconsidering their escalation management strategies in light of these newly discovered weaknesses. While these developments may make a potential future crisis with Russia more dangerous and destabilizing, they also offer opportunities for the United States and its allies to better prepare themselves to respond resolutely against any Russian aggression. By understanding how an unreliable nonnuclear deterrent will impact Russia's nuclear escalation management strategy, U.S. policymakers will be better placed to continue deterring Russia and prevent it from realizing its revisionist ambitions.

The Nexus of Technology and Nuclear Weapons

Beyond "Human in the Loop"

A Study of the Impact of Emerging and Disruptive Technologies on Individual Nuclear Decisionmaking Processes

By Julia Cournoyer[1]

In an era where the United States finds itself confronting two nuclear-armed peer adversaries for the first time in its history, the salience of nuclear weapons has surged, capturing the attention of policymakers, scholars, and concerned citizens alike. Amid this evolving landscape, research on the nexus between individual psychology and nuclear weapons decisionmaking is needed more than ever. For example, since Russia's 2022 invasion of Ukraine, scholars have increasingly sought to understand Putin's individual psychology and align that with an understanding of rationality in nuclear weapons policy to draw conclusions on the decisions Putin might take. However, the introduction of emerging technologies, including artificial intelligence (AI) and cyber operations, into the decisionmaking environment might change interpretation of an individual and their decisionmaking architecture. Will emerging technologies constrain the amount of time one has to make a decision in a nuclear environment? Will further time constraints impact biases, instincts, and the processing of information in nuclear decisionmaking?

This paper aims to address these questions by examining the influence of emerging and disruptive technologies (EDTs) on nuclear decisionmaking, focusing on overarching trends and patterns rather than conducting individual assessments of each technology. On the one hand, understanding the role of the individual in nuclear decisionmaking is crucial to account for human biases, heuristics, and cognitive limitations in the process. On the other hand, current approaches fail to account for

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how EDTs impact the individual and their decisionmaking architecture. To reconcile this paradox, this paper examines the influence of EDTs on individual and collective psychological decisionmaking processes in nuclear policy. This study provides recommendations for policymakers to enhance their understanding of the effects of emerging technologies on decisionmaking environments and decisionmakers. This qualitative study employs an interdisciplinary approach, drawing on insights from academic work and historical examples from the fields of psychology, behavioral economics, and decisionmaking analysis to ensure a well-rounded understanding of the topic's scope and complexity. As these technologies are integrated more deeply into strategic operations, understanding their implications on decisionmaking processes is paramount to maintaining stability and mitigating miscalculations in the nuclear domain.

This paper is organized into three main sections. The first section presents a literature review on emerging technologies and decisionmaking. The second section delves into a detailed analysis of the impact of these technologies on various aspects of nuclear decisionmaking, including the influence on time, biases, and information processing in decisionmaking. These categories—time, biases, and information processing—are central to the decisionmaking process and are selected as focus areas because of their fundamental role in shaping the cognitive environment of decisionmakers. The third section presents recommendations and policy-relevant solutions, derived from the paper's findings and analysis, to enhance policymakers' understanding of the effects of emerging technologies on decisionmaking environments and individual psychology in nuclear policy, ultimately aiming to contribute to risk reduction in decisionmaking.

LITERATURE REVIEW ON EDTS AND NUCLEAR DECISIONMAKING

The literature on emerging technologies and nuclear decisionmaking is burgeoning, with most recent studies focusing on the impact of EDTs on nuclear decisionmaking, such as cyber operations, AI, or quantum computing.[2] This research has sought to identify the potential benefits and risks of individual EDTs and their impact on nuclear decisionmaking. There is also, more specifically, a noticeable growth in the body of literature exploring the effects of AI on nuclear and crisis decisionmaking, leading to increasingly important inquiries and discussions in this field.[3] More recent work by Jacek Durkalec et al. also fills a notable gap in the existing literature by analysing the *collective* impact and effect of these EDTs on the nuclear decisionmaking environment more generally.[4] Missing from the literature, however, is a discussion on how the collective effects of

2 See Katarzyna Kubiak and Sylvia Mishra, "Emerging & Disruptive Technologies and Nuclear Weapons Decision Making: Risks, Challenges & Mitigation Strategies," European Leadership Network, 2021, https://www.boell.de/sites/default/files/2022-02/Emerging%20disruptive%20technologies%20and%20nuclear%20weapons%20decision%20making_Report.pdf; Natasha E. Bajema and John Gower, *A Handbook for Nuclear Decision-Making and Risk Reduction in an Era of Technological Complexity* (Washington, DC: Council on Strategic Risks, 2022), https://councilonstrategicrisks.org/wp-content/uploads/2022/12/NuclearTechnologicalComplexity-Dec22.pdf; Jessica Cox and Heather Williams, "The Unavoidable Technology: How Artificial Intelligence Can Strengthen Nuclear Stability," *Washington Quarterly* 44, no. 1 (March 2021), https://doi.org/10.1080/0163660X.2021.1893019; James Johnson, "'Catalytic Nuclear War' in the Age of Artificial Intelligence & Autonomy: Emerging Military Technology and Escalation Risk between Nuclear-Armed States," *Journal of Strategic Studies* (2021): 1–41, doi.org/10.1080/01402390.2020.1867541; and Matthew Kroenig, "Will Emerging Technology Cause Nuclear War?: Bringing Geopolitics Back In," *Strategic Studies – Deterrence* 15, no. 4 (2021), https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-15_Issue-4/D-Kroenig.pdf.

3 See, among others, Cox and Williams, "The Unavoidable Technology"; Michael C. Horowitz and Erik Lin-Greenberg, "Algorithms and Influence Artificial Intelligence and Crisis Decision-Making," *International Studies Quarterly* 66, no. 4 (December 2022), https://doi.org/10.1093/isq/sqac069; and Johnson, "'Catalytic Nuclear War.'"

4 Jacek Durkalec, A. Peczeli, and B. Radzinsky, *Nuclear Decisionmaking, Complexity and Emerging and Disruptive Technologies: A*

these EDTs impact the individual directly involved in the nuclear decisionmaking process, and thus the nuclear decisionmaking environment.[5] Psychology, more generally, is "underappreciated when examining the relationship between crisis decision-making and emerging technology," and thus this paper aims to begin to address this gap by initiating a discussion on the collective influence of EDTs on individuals and the overall nuclear decisionmaking environment, raising pivotal questions and opening avenues of exploration in this understudied area.[6] Organizational silos within governments also serve to further separate discussions on emerging technologies, nuclear weapons, and the individual involved in the decisionmaking process, potentially leading to an incomplete understanding of the interplay between these elements.[7]

Furthermore, previous research on nuclear decisionmaking has highlighted the importance of human judgment in preventing catastrophe and correcting potential technology errors.[8] However, this paper posits that the concept of the "human in the loop" or human decisionmaking may no longer hold the same meaning in nuclear decisionmaking, as the integration of machines and technology into decisionmaking processes may fundamentally alter human behavior and cognition. The assumption that humans and technology are separate entities overlooks the fact that these technologies are created, programmed, and used by humans, in turn affecting human perception and decisionmaking processes.

EDTs can be defined as innovations that have the potential to radically alter existing systems or industries, while nuclear decisionmaking encompasses the processes and choices involved in the development, deployment, and use of nuclear weapons. In this paper, a broad understanding of EDTs has been adopted to include cyber operations, AI and machine learning, quantum technologies, hypersonic weapons, social media, and other technologies that have the potential to disrupt the decisionmaking environment.[9] This research does not aim to determine whether EDTs have a stabilizing or destabilizing effect on nuclear policy but rather seeks to analyze their impact on human behavior and the potential consequences for nuclear decisionmaking.[10]

The literature on the psychology of decisionmaking, separate to the field of nuclear weapons policy, provides valuable insights into biases and heuristics, information processing, time constraints, and the impact of stress and emotions that can be applied to the study of nuclear decisionmaking. The work of renowned psychologists, including Daniel Kahneman and Amos Tversky, have recently become more prominent in disussions on nuclear decisionmaking, but nuclear policy is yet to harness the full remit of psychological understanding of these processes for application to the nuclear

Comprehensive Assessment (Washington, DC: Office of Scientific and Technical Information, Department of Energy, February 2022), https://www.osti.gov/servlets/purl/1843557.

5 This study on nuclear decisionmaking is situated within the broader context of the literature on the limitations of rationality in decisionmaking, see James D. Fearon, "Rationalist Explanations for War," *International Organization* 49, no. 3 (Summer 1995): 379–414, https://www.jstor.org/stable/2706903; Min Ye, "Poliheuristic Theory, Bargaining, and Crisis Decision-Making," *Foreign Policy Analysis* 3, no. 4 (October 2007): 317–344, https://www.jstor.org/stable/24907296; and Bradley A. Thayer, "Thinking about Nuclear Deterrence Theory: Why Evolutionary Psychology Undermines Its Rational Actor Assumptions," *Comparative Strategy* 26, no. 4 (October 2007): 311–323, https://doi.org/10.1080/01495930701598573.

6 Rebecca Hersman et al., *Under the Nuclear Shadow: Situational Awareness Technology and Crisis Decisionmaking* (Washington, DC: CSIS, 2020), https://www.csis.org/analysis/under-nuclear-shadow-situational-awareness-technology-and-crisis-decisionmaking.

7 Michal Onderco and Madeline Zutt, "Emerging Technology and Nuclear Security: What Does the Wisdom of the Crowd Tell Us?," *Contemporary Security Policy* 42, no. 3 (2021): 297, https://doi.org/10.1080/13523260.2021.1928963.

8 Ibid., 295.

9 Heather Williams and Alexi Drew, *Escalation by Tweet: Managing the New Nuclear Diplomacy* (London: Kings College London, Centre for Science and Security Studies, July 2020), 5, https://www.kcl.ac.uk/csss/assets/escalation-by-tweet-managing-the-new-nuclear-diplomacy-2020.pdf.

10 See Cox and Williams, "The Unavoidable Technology."

context.[11] It is important to note that the present work is subject to certain caveats, such as cultural, societal, political, and military considerations that may differ between countries.[12] These factors, which can vary greatly between different countries, may influence how emerging technologies are perceived and used, potentially affecting the decisionmaking processes in ways not fully covered in this analysis. Nevertheless, this research contributes to a deeper understanding of the interplay between emerging technologies, psychological processes, and nuclear decisionmaking, emphasizing the need for a more integrated approach that accounts for both the human and technological aspects of this critical domain.

THE IMPACT OF TECHNOLOGIES ON DECISIONMAKING

THE IMPACT OF EDTS ON TIME IN NUCLEAR DECISIONMAKING

EDTs have the potential to significantly alter the dynamics of nuclear decisionmaking by impacting on the time available for those involved to deliberate and act. In nuclear decisionmaking, time often emerges as the central challenging variable.[13] This section seeks to examine the potential risks and benefits of faster or slower decisionmaking in a nuclear crisis, explore how emerging technologies may change the time available for decisionmaking, and analyze the implications of these changes on the individual involved in nuclear decisionmaking.

There is a general assumption that shorter time periods allow for less deliberation, leading to more psychological "shortcuts" and "fast thinking."[14] Numerous psychological studies have delved into the influence of time constraints on risky decisionmaking, revealing how these constraints can prevent decisionmakers from fully considering all aspects or attributes of a decision.[15] For these reasons, nuclear weapons states have historically "sought to increase this decision-making time."[16] While slower decisionmaking is often considered more deliberative, it is important to question whether nuclear decisionmaking should always be deliberative. Some argue that gut instincts—intuitive judgments that are made quickly and without conscious reasoning—can be valuable in certain crisis decisionmaking situations.[17] The 1983 Soviet false-alarm incident serves as a notable example of reliance on instincts in situations with tight decisionmaking timeframes. In this case, Lieutenant Colonel Stanislav Petrov, the attending Soviet officer of an early warning satellite system, attributed his decision not to alert his superiors about a (later confirmed to be false) alarm of an impending nuclear attack to a "funny feeling in his gut."[18] This instinctive judgment is widely recognized as having helped avert a potential crisis.[19] This compressed timeframe for decisionmaking aligns with

11 See Daniel Kahneman, *Thinking Fast and Slow* (London: Penguin Books, 2011); and Amos Tversky and Daniel Kahneman, *Judgment under Uncertainty: Heuristics and Biases* (Cambridge, UK: Cambridge University Press, 1982), 3–20, https://doi.org/10.1017/cbo9780511809477.002.

12 Durkalec, Peczeli, and Radzinsky, *Nuclear Decisionmaking, Complexity and Emerging and Disruptive Technologies*, 5.

13 "Nuclear decision-making and nuclear war: an urgent American problem," War Room, November 8, 2018, https://warroom.armywarcollege.edu/articles/nuclear-decision-making/.

14 For detailed psychological analysis on psychological shortcuts and "fast" and "slow" thinking, see Kahneman, *Thinking Fast and Slow*.

15 Adele Diederich, "MDFT Account of Decision Making under Time Pressure" *Psychonomic Bulletin* 10, no. 1 (2003): 164, https://doi.org/10.3758/bf03196480; and Lisa Ordóñez and Lehman Benson, "Decisions under Time Pressure: How Time Constraint Affects Risky Decision Making," *Organizational Behavior and Human Decision Processes* 71, no. 2 (1997): 121–40, https://doi.org/10.1006/obhd.1997.2717..

16 See Cox and Williams, "The Unavoidable Technology," 73.

17 Daniel Kahneman, "Of 2 Minds: How Fast and Slow Thinking Shape Perception and Choice," *Scientific American*, June 15, 2012, https://www.scientificamerican.com/article/kahneman-excerpt-thinking-fast-and-slow/.

18 Daniel Hoffman, "I Had A Funny Feeling in My Gut," *Washington Post*, February 10, 1999, https://www.washingtonpost.com/wp-srv/inatl/longterm/coldwar/soviet10.htm.

19 For further information, see Beyza Unal, Julia Cournoyer, Yasmin Afina, and Calum Inverarity, *Uncertainty and Complexity in*

the work of psychologists such as Kahneman, who suggest that such situations often trigger "fast" or "System 1" thinking processes, wherein individuals adopt heuristics or mental shortcuts. These heuristics could potentially modify the decision outcomes, as they bypass the more deliberate and analytical "slow-thinking" processes.

Emerging technologies can both compress and extend the time available for decisionmaking. As Durkalec et al. note, adversaries' use of combinations of technology that compress decision times, such as hypersonic missiles, swarm robotics, autonomous systems, or kinetic counter-space capabilities, makes it challenging for national leaders to assess, deliberate, and act in a timely manner.[20] Hypersonic weapons, and the unprecedented speed (Mach 5 and above) in which they can reach a target, can significantly shorten decision timelines, potentially amplifying the cognitive biases discussed in this paper. Moreover, their dual-use nature adds complexity by blurring the ability to distinguish whether an incoming strike carries a conventional or nuclear payload, further complicating the decisionmaking process and introducing uncertainties.[21] Cyber capabilities could also be used to trick decisionmakers into believing a nuclear attack has already begun, prompting hasty decisions.[22] While humans have historically averted some instances of nuclear disaster by relying on their instinct reactions (as is the case in the Soviet false-alarm incident and Able Archer 83), the introduction of these technologies adds new layers of complexity and uncertainty to the decisionmaking process.[23] This paper posits an interconnected view of the human element and the technologies involved in these decisionmaking processes. This perspective challenges the commonly held assumption that humans and technology operate as separate entities. Instead, it underscores the reality that technology, which is created, programmed, and used by humans, reciprocally shapes human perception and decisionmaking processes.

In some cases, technological advancements such as AI or advanced data analytics may provide decisionmakers with more timely information, potentially reducing the reliance on instinct and emotion in decisionmaking. However, the increasing integration of technology into the decisionmaking process may lead to a diminished role for intuition and gut instincts, with potential consequences for decision quality and adaptability. For example, in the Able Archer 83 and Soviet false-alarm cases of near nuclear use, the individuals responsible for taking decisions during these incidents referred to their "intuitive" decisions as well as "gut instinct." As mentioned earlier, Lieutenant Colonel Petrov famously refers to a "funny feeling in his gut" as a critical part of his decision rationale, and one of the critical reports following Able Archer highlighted how a key actor, Lieutenant General Leonard Perroots, "acted correctly out of instinct, not informed guidance."[24]

Nuclear Decision-Making (London: Chatham House, March 2022), https://www.chathamhouse.org/sites/default/files/2022-03/2022-03-07-nuclear-decision-making-unal-et-al_1.pdf.

20 Durkalec, Peczeli, and Radzinsky, "Nuclear Decisionmaking, Complexity and Emerging and Disruptive Technologies," 17.

21 Carrie A. Lee, "Asking the right questions: hypersonic missiles, strategic stability, and the future of deterrence" in *Recalibrating Nuclear Policy*, Andrea Gilli, ed., (Rome: NATO Defence College 2020), 30, https://www.jstor.org/stable/resrep25147.9.

22 James Johnson and Eleanor Krabill, "AI, Cyberspace, and Nuclear Weapons," War on the Rocks, January 31, 2020, https://warontherocks.com/2020/01/ai-cyberspace-and-nuclear-weapons/.

23 This case is elaborated on in Sections 2.2 and 2.3. For further exploration of cases of near nuclear use, see Patricia Lewis, Benoit Pelopidas, and Heather Williams, *Too Close for Comfort: Cases of Near Nuclear Use and Options for Policy* (London: Chatham House, April 2014), https://www.chathamhouse.org/2014/04/too-close-comfort-cases-near-nuclear-use-and-options-policy; and Beyza Unal et al., *Uncertainty and Complexity in Nuclear Decision-Making* (London: Chatham House, March 2022), https://www.chathamhouse.org/sites/default/files/2022-03/2022-03-07-nuclear-decision-making-unal-et-al_1.pdf.

24 President's Foreign Intelligence Advisory Board, *The Soviet "War Scare"* (Washington, DC: February 1990), declassified October 14, 2015, x, https://www.archives.gov/files/declassification/iscap/pdf/2013-015-doc1.pdf.

The references to gut instinct and intuition being at play in nuclear decisionmaking cases are frequent and used in opposition to the category of so-called information. This frame of thinking, with information and intuition being placed in opposition to one another, creates an interesting fallacy when studying behavior in nuclear decisionmaking, as there is no real clear-cut boundary between decisions built on intuition or information—the two are inherently mutually reinforcing. Information informs intuition and vice versa. However, increased information availability can also be a double-edged sword. While EDTs may generate more information for decisionmakers, filtering through this information can be time consuming and lead to information overload. To counter this, EDTs can also be utilized to filter and analyze information more efficiently, although decisionmakers may exhibit undue trust and insufficient scrutiny toward digital tools. The potential trade-offs between decision speed and decision quality in nuclear decisionmaking are an important consideration, as is the role of EDTs in balancing these factors.

THE IMPACT OF EDTS ON BIASES IN NUCLEAR DECISIONMAKING

EDTs have the potential to both exacerbate and mitigate cognitive biases in nuclear decisionmaking. This section will analyze how biases related to perception, memory, judgment, and decisionmaking heuristics may be affected by these technologies. Likewise, it will examine the role of technological interfaces and displays, human-machine interactions, and the impact of biases on different stakeholders in the nuclear decisionmaking process.

Emerging technologies can introduce new sources of bias or amplify existing ones. For instance, AI systems may inherit biases from the data they are trained on, due in part to the lack of diversity in the science, technology, engineering, and medicine (STEM) workforce or the unconscious biases of developers.[25] The increasing integration of AI into everyday life and its ability to simulate human voices, linguistic patterns, personalities, and appearances may further blur the line between humans and technology, potentially altering decisionmaking dynamics.[26] These blurred lines may subconsciously impact on the individual involved in nuclear decisionmaking as the reliance on AI systems for information and analysis introduces new complexities and challenges. The integration of AI technology in this domain raises questions about the extent to which decisionmakers may rely on AI-driven recommendations or assessments, potentially diminishing their own expertise and judgment. Additionally, the infusion of AI into decisionmaking processes may create a sense of detachment or responsibility transfer, as decisionmakers may view AI systems as a form of accountability or justification for their choices. This shift in decisionmaking dynamics has significant implications for nuclear weapons policy, where accurate and informed judgments are paramount.

EDTs can also potentially exacerbate biases and increase the likelihood of errors by contributing to information overload. The interplay between humans and technology can further affect these biases. In some cases, decisionmakers may over-rely on AI recommendations (also known as automation bias), thereby failing to critically assess system outputs or consider alternative action paths.[27] Conversely, an inherent skepticism or resistance to technological advancements may lead individuals

25 Kubiak and Mishra, "Emerging & Disruptive Technologies," 3.

26 Caitlin Chin and Mishaela Robison, "How AI Bots and Voice Assistants Reinforce Gender Bias," Brookings Institute, November 23, 2020, https://www.brookings.edu/research/how-ai-bots-and-voice-assistants-reinforce-gender-bias/.

27 Once AI systems become viable in a given arena, research from human factors engineering suggests that humans often defer to information and advice from automated decisionmaking systems, known as automation bias. See M.L. Cummings, "Automation Bias in Intelligent Time Critical Decisions Support Systems," AIAA 1st Intelligent Systems Technical Conference, Chicago, IL, September 20–24, 2004, https://doi.org/10.2514/6.2004-6313; and Horowitz and Lin-Greenberg, "Algorithims and Influence," 7.

to dismiss valuable insights provided by AI systems, fueled by concerns over their reliability or ethical implications. A recent survey substantiates this issue. It found that when an intelligence assessment conducted by humans was presented to 320 U.S. national security experts, over 72 percent were likely to support military action; however, when the respondents were told that an identical intelligence assessment was conducted using AI, the support for military action markedly dropped to 49.6 percent.[28] This variation underscores the prevalence of automation or algorithm aversion bias, a bias where individuals exhibit a preference for human judgment over machine-led decisionmaking.

Biases may also differently affect the various stakeholders in the nuclear decisionmaking process, including political leaders, military commanders, and intelligence analysts. Political leaders may be influenced by biases related to their personal beliefs, political ideologies, or electoral considerations, while military commanders may be prone to biases associated with military doctrine and operational priorities. Intelligence analysts, likewise, may face biases stemming from information-processing limitations and prior expectations. This was evident, for example, in Operation RYAN, a Soviet intelligence-gathering operation that called for the collection of intelligence to reinforce the existing belief that the United States was preparing for its own nuclear first strike.[29] This operation initiated a loop of dangerously self-reinforcing feedback and added to uncertainty in the nuclear decisionmaking environment.

Emerging technologies may amplify or mitigate these biases, depending on factors such as technology design, integration, and adoption. For example, AI systems may improve intelligence analysis by identifying patterns or threats that humans might overlook, potentially reducing biases related to perception or confirmation. Conversely, emerging technologies could exacerbate biases in military planning or political decisionmaking if they promote groupthink, overconfidence, or other cognitive pitfalls.

The potential risks and benefits of using emerging technologies to counter biases in nuclear decisionmaking must be carefully evaluated. EDTs such as AI systems or advanced data analytics can improve decisionmaking by reducing some cognitive biases and providing more accurate, timely information. Yet, overreliance on technology may lead to new biases, complacency, or ethical dilemmas. Emerging technologies can introduce various forms of bias, such as technology-generated bias (i.e., inherent biases in AI systems), technology development bias (i.e., biases stemming from the developers' perspectives), bureaucratic biases (i.e., biases related to organizational structures and processes), and advisory and advisory process bias (i.e., biases arising from the influence of advisers on the decisionmaking process). EDTs can also exacerbate existing biases, as is evident from the Able Archer incident, where the Soviet Union misinterpreted a NATO military exercise as the prelude to a nuclear strike due to its existing belief or hypothesis of a hostile United States preparing for a first-strike attack. The Soviet Union's response to the Able Archer exercise underscores the power of confirmation bias—the psychological predisposition to interpret new evidence in ways that align more closely with existing beliefs, expectations, or hypotheses.[30] In this case, the confirmation bias potentially contributed to nuclear escalation, highlighting the critical importance of identifying and mitigating such biases in nuclear decisionmaking contexts.

28 Horowitz and Lin-Greenberg, "Algorithms and Influence," 13.
29 Arnav Manchanda, "When Truth Is Stranger than Fiction: The Able Archer Incident," *Cold War History* 9, no. 1 (2009), 117, https://doi.org/10.1080/14682740802490315.
30 Johnson, "'Catalytic Nuclear War'," 10.

The impact of emerging and disruptive technologies on biases in nuclear decisionmaking is complex and multifaceted, reinforcing the interconnected nature of humans and technologies in the decisionmaking process. While these technologies offer the potential to reduce cognitive biases and improve decisionmaking, they may also introduce new forms of bias in individuals or exacerbate existing ones. By understanding and addressing the various forms of bias and the ethical and moral implications of using EDTs in nuclear decisionmaking, policymakers, military leaders, and intelligence analysts can ensure that these technologies are employed responsibly and effectively, ultimately enhancing global security and reducing the risk of nuclear conflict.

THE IMPACT OF EDTS ON INFORMATION PROCESSING IN NUCLEAR DECISIONMAKING

Emerging technologies have the potential to significantly affect information processing in nuclear decisionmaking, influencing aspects such as perception, attention, memory, and decisionmaking heuristics. Understanding how emerging technologies may distort the information landscape in decisionmaking environments for nuclear weapons has become increasingly necessary. In nuclear policy, there is often a warped perception that actors behave and operate with complete information—that is, with all the information necessary to make a fully informed decision and, furthermore, under the assumption that such information exists. However, nuclear weapons policy is often intentionally fraught with ambiguity and uncertainty, which play a key role in strategy and thus can contribute to incomplete or contradictory information. The introduction of emerging technologies into the decisionmaking environment for nuclear weapons policy likely contributes to this complex dynamic, impacting on the balance between information and intuition in decisionmaking and distorting the way individuals interact with the information presented to them. Thus, when analyzing behavior in nuclear weapons decisionmaking, an informed decision does not imply infallibility. It is crucial to recognize these potential distortions in decisionmaking and address them to ensure that emerging technologies are used responsibly and effectively in nuclear decisionmaking.

In this context, technology could also alter how nuclear decisionmakers assess not only their own information but that of their rivals. Information derived from systems enabled by AI or other emerging technology could influence how decisionmakers perceive a rival's capabilities or intentions. Moreover, when a rival employs AI-enabled weapons, it could further complicate decisionmakers' understanding of the rival's intentions.[31] The introduction of these emerging technologies into the decisionmaking environment for nuclear weapons policy further complicates an already intricate dynamic. This complexity contributes to two potentially escalatory decisionmaking scenarios: decision paralysis and biased decisionmaking.[32] Decision paralysis refers to the inability to make or finalize a decision within the required time frame due to overwhelming information or lack thereof. Biased decisionmaking occurs when belief or cognitive biases excessively intrude on the decisionmaking process, diminishing or discrediting objective data and distorting decisional outcomes.

While the influence of emerging technologies such as AI on decisionmaking has been substantial, it is critical to consider other sources of digital disruption, notably the impact of social media, which can potentially interfere with information processing and availability.[33] The constant background activity and information overload associated with social media can lead to distorted perceptions, misinformation, and heightened anxiety, all of which can negatively impact decisionmaking.

31 Horowitz and Lin-Greenberg, "Algorithms and Influence," 5.
32 Hersman et al., *Under the Nuclear Shadow*, 38.
33 Williams and Drew, *Escalation by Tweet*, 5.

Decisionmakers may also be subject to anchoring bias, relying too heavily on the first piece of information they receive, which may be further exacerbated by the rapid pace of information dissemination on social media. In the context of nuclear decisionmaking, this torrent of potentially skewed or misleading information can escalate tensions, fuel misunderstandings, and even precipitate rash decisions, thus altering the trajectory of nuclear policy and potentially raising the risk of conflict.

Human-machine interactions may also influence the role of instincts in nuclear decisionmaking. For example, decisionmakers may develop an overreliance on technology, neglecting to consider their instincts or intuition when evaluating options or interpreting data. Alternatively, they may exhibit skepticism or resistance to new technologies, favoring their instincts over potentially valuable insights provided by AI systems or other advanced tools. Similar to biases, instincts may differently affect the various stakeholders in the nuclear decisionmaking process, including political leaders, military commanders, and intelligence analysts. These instincts may interact with other factors such as cognitive biases, political pressures, and situational constraints, shaping the ultimate decisions made in a nuclear context. Understanding these interactions and their potential consequences is essential for developing effective strategies and policies for managing nuclear risks. During the Soviet false-alarm incident, Lieutenant Colonel Petrov's gut instinct to question the technology-generated data and alerts from early warning systems prevented a potentially catastrophic nuclear exchange. Similarly, in the Able Archer exercise, Lieutenant General Perroots' decision to avoid escalation, based on his instincts, averted a potential crisis. These examples highlight the importance of acknowledging and integrating instincts into the decisionmaking process, particularly when dealing with complex, high-stakes situations.

POTENTIAL MITIGATION AND POLICY-RELEVANT SOLUTIONS

The impact of emerging and disruptive technologies on nuclear decisionmaking environments and the psychology of decisionmakers raises concerns about the potential risks and consequences of nuclear weapons use. To reduce these risks, policymakers must take a proactive approach to enhance their understanding of the effects of EDTs on nuclear decisionmaking environments and individual psychology. This section presents policy-relevant solutions and potential mitigation measures that can enhance the decisionmaking process in nuclear policy.

ENHANCING AWARENESS AND EDUCATION

The integration of EDTs into nuclear decisionmaking environments presents a significant challenge for decisionmakers who may not be familiar with the technologies and their potential impacts. Therefore, policymakers should prioritize educating current and future decisionmakers on emerging technologies and their impacts on nuclear decisionmaking. This can include training programs, workshops, and simulations that help decisionmakers understand the capabilities and limitations of EDTs and their impact on human decisionmaking processes. Moreover, policymakers must foster a culture of awareness and encourage ongoing dialogue and exchange of ideas between decisionmakers and technology experts to ensure that emerging technologies are integrated effectively and safely, de-siloing the two fields of study. In the study of nuclear weapons systems and decisionmaking, there also needs to be a greater emphasis on the study of individual actors and their behavior. As much as one examines complexity within the entire system of nuclear weapons policy, what this research has highlighted is that the focus should also be on the people that operate the technology and the behavioral complexity at every level of decisionmaking.

DESIGNING DECISIONMAKING PROCESSES TO ACCOUNT FOR EDTS

The integration of EDTs into decisionmaking processes can alter the decisionmaking environment by introducing new biases and cognitive limitations. Therefore, policymakers must design decisionmaking processes that account for the impact of EDTs on human behavior and cognition. Policymakers should prioritize designing decisionmaking processes that enable effective communication between decisionmakers and technology experts. This can facilitate a shared understanding of emerging technologies and their impact on the decisionmaking environment, ensuring that decisionmakers can make informed and effective decisions. Psychologists can help to contribute to a "decisionmaking-by-design" approach and ensure that decisionmaking processes are not only technically sound but also psychologically informed, ultimately contributing to the reduction of risk in nuclear policy decisionmaking.

CONFIDENCE-BUILDING MEASURES

The integration of emerging technologies into nuclear decisionmaking environments raises concerns about the potential for decisionmaking processes to be compromised or manipulated. Therefore, policymakers must prioritize confidence-building measures (CBMs) that can enhance transparency and reduce the risk of misperception and miscalculation in nuclear decisionmaking environments. This can involve establishing protocols for communication and information sharing, including early warning systems, notification of military exercises, and joint threat assessments.

Moreover, policymakers must encourage collaboration between decisionmakers, technology experts, and other stakeholders to ensure that decisionmaking processes are transparent and collaborative. This can involve establishing partnerships and collaboration agreements between governments, international organizations, and other stakeholders to ensure that EDTs are integrated safely and effectively into decisionmaking processes.

CONCLUSION

In conclusion, this paper aims to provide insights into the impact of emerging and disruptive technologies on individual and collective psychological decisionmaking processes in the context of nuclear policy. The thesis of this research posits that humans and machines are not separate entities but intricately linked in the decisionmaking process, with machines being created, programmed, and utilized by humans, ultimately influencing human perception and decisionmaking processes reciprocally. By examining how EDTs influence decisionmaking dynamics, biases, and information processing, this research contributes to the growing body of knowledge at the intersection of psychology and nuclear decisionmaking. It highlights the critical importance of recognizing and understanding the complex interplay between humans and EDTs in the ever-evolving landscape of nuclear policy and decisionmaking. The findings highlight the significance of understanding how EDTs shape decisionmaking environments and the role of human behavior in this complex interplay.

The implications of this research extend beyond theoretical considerations. Decisionmakers in nuclear weapons policy need to be aware of the biases introduced by EDTs and their potential impact on decisionmaking processes. Policymakers should develop guidelines and regulations to ensure responsible and ethical use of emerging technologies in nuclear decisionmaking. Furthermore, training programs and educational initiatives should be implemented to enhance decisionmakers' understanding of EDTs and foster critical thinking in assessing their recommendations and assessments. The importance of understanding the impact of emerging technologies on nuclear

decisionmaking cannot be overstated in today's global landscape, where nuclear weapons continue to hold significant importance.

This paper has taken a generalized approach by considering EDTs as a collective entity that includes technologies such as AI. While this approach has allowed for drawing broad conclusions, future research should aim to unpack the specific effects of different EDTs on individual psychology within the nuclear decisionmaking chain of command. It is crucial to conduct more detailed analyses, particularly within specific technology areas such as AI, to gain a "greater degree of granularity" and deeper understanding of their nuanced impact on nuclear weapons policies.[34] Future studies should also seek to explore additional dimensions, such as the ethical considerations and potential policy implications arising from the integration of EDTs in the nuclear domain. By pursuing these avenues of research, nuclear policy practitioners and experts can enhance their understanding of the intricate interplay between emerging technologies, individual psychology, and nuclear decisionmaking processes.

This research underscores the need for a comprehensive understanding of how EDTs influence decisionmaking dynamics and the importance of incorporating human factors and psychological principles into the design of decisionmaking processes. By deepening knowledge in this field, the nuclear weapons policy community can navigate the challenges posed by emerging technologies while harnessing their potential benefits, ultimately ensuring the responsible and effective use of these technologies in maintaining global security and minimizing the risk of nuclear use.

34 Cox and Williams, "The Unavoidable Technology," 70.

Eyes on the Bomb

The Technical Dimension of Nuclear Compellence

By Decker Eveleth[1]

INTRODUCTION

In June 2023, in an act to assure South Korea about United States' defense commitments, an Ohio-class ballistic missile submarine made a port call at the South Korean city of Busan.[2] The visit prompted a sharp rebuke from North Korea. The day the submarine docked, North Korea fired two short-range ballistic missiles into the Sea of Japan.[3] Both missiles traveled around 550 kilometers, the same distance between the missile's launch sites and the port of Busan. Two days later, the North Korean minister of national defense made the threat explicit:

> I remind the U.S. military of the fact that the ever-increasing visibility of the deployment of the strategic nuclear submarine and other strategic assets may fall under the conditions of the use of nuclear weapons specified in the DPRK law on the nuclear force policy. The DPRK's doctrine on the use of nuclear weapons allows the execution of necessary action procedures in case a nuclear attack is launched against it or it is judged that the use of nuclear weapons against it is imminent.[4]

The message was clear: if North Korea sees the United States moving military assets and believes that a U.S. first strike is imminent, they will strike first. But how will North Korea see the threat?

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2 Heather Mongilio, "USS Kentucky Make Port Call in South Korea, First SSBN Visit in 40 Years," USNI News, July 18, 2023. https://news.usni.org/2023/07/18/uss-kentucky-calls-in-south-korea-first-ssbn-visit-in-40-years.

3 Tong-Hyung Kim and Hyung-Jin Kim, "North Korea Fires 2 Short Range Missiles into the Sea as US Docks Nuclear Submarine in South Korea," AP News, July 18, 2023, https://apnews.com/article/north-korea-missiles-us-nuclear-submarine-9a915fab65631ad2094f78e0d1d942cf.

4 "Press Statement of Minister of National Defense of DPRK," Korea Central News Agency, July 20, 2023, https://kcnawatch.org/newstream/1689858458-777275448/press-statement-of-minister-of-national-defence-of-dprk/.

Besides a single imagery satellite and a limited drone capability, North Korea has effectively no long-range overhead intelligence, surveillance, and reconnaissance (ISR) capability. Their access to satellite imagery is limited, and their early-warning infrastructure is in a state of decay. This suggests that during a crisis between the United States and North Korea, the latter will be making important decisions based on extremely limited information about the movement of U.S. and South Korean military forces. Under a scenario in which the United States is attempting to coerce North Korea into ceasing an offensive action, North Korea may not be able to distinguish between U.S. military movements intended for coercion and military movements that prelude an imminent attack.

This paper will examine the underdiscussed technical aspects of nuclear compellence. For compellence to be successful, the state being compelled must be able to both see and correctly interpret the movements of military hardware. This requires a robust ISR capability, as the state being coerced must have data on military movements with the necessary granularity to separate anomalies from normal operating procedures and exercises from real military actions. The dramatic expansion of open-source intelligence provides real-life examples of the problems faced by analysts when there is a high demand for information in a limited information environment.

During Russia's invasion of Ukraine in 2022, nongovernmental open-source analysts and media outfits, operating under limited sources of information, attempted to glean as much information as possible on near-term Russian military actions. Many of these open-source analysts, dealing with short-term military actions and movements, turned to tools and methods that were new, unfamiliar, or only involved limited amounts of data, encountering serious problems while attempting to interpret that data. As such, the experience of open-source analysts and journalists during the war is an interesting analog to U.S. regional adversaries, as regional powers attempting to gain information about U.S. military operations with limited ISR resources may run into the exact same problems. This paper will examine several case studies from the war in Ukraine, each with lessons on how regional adversaries might address the limited-intelligence problem.

NUCLEAR COERCION

Nuclear coercion refers to the theoretical ability of nuclear weapon states to force an adversary to change its behavior by threatening the use of nuclear weapons. One of the clearest descriptions of the theory behind this comes from Thomas Schelling's *Arms and Influence*, which defines and differentiates between the two types of coercion: activities meant to deter and activities meant to compel. Compellence actions refer to "threats intended to make an adversary do something," while deterrence actions refer to "threats intended to keep [an adversary] from starting something."[5] Deterrence is generally a passive action, while compellence must involve some sort of movement or deviation from business as usual. Berlin during the Cold War is a clear example of the difference. During the Cold War, the United States deployed the Berlin Brigade, a force of roughly 5,000 troops, to hold the city, despite being surrounded by hundreds of thousands of Soviet troops. These forces were intended to deter Soviet military action by ensuring that any Soviet seizure of the city would result in significant U.S. casualties, thus sparking a general war. The Soviets, likewise, could still attempt to compel the United States to withdraw from Berlin by threatening precisely that military action, as they did during the Berlin Crisis of 1961, where Soviet tanks faced U.S. tanks in a tense standoff. Nuclear compellence operates on the same basic principle, but with much higher stakes.

5 Thomas Schelling, *Arms and Influence* (New Haven, CT: Yale University Press, 1966), 69.

In 1969, the Nixon administration put this idea into practice with Operation Giant Lance, flying nuclear-armed U.S. bombers close to the Soviet Union in an effort to force the Soviets to pressure the North Vietnamese into a diplomatic solution to the war in Vietnam. Nixon communicated to the Soviets that he wanted a breakthrough on the Vietnam peace process by November 1 and concordantly ordered bomber flights to be conducted off the Soviet Union's Arctic coast during much of October. Nixon's compellence attempt failed to generate any Soviet action at all, and much has been written recently as to why. Scott Sagan and Jeremi Suri concluded that this was due to the Nixon administration's failure to clearly link the bomber flights with Vietnam.[6] Despite Secretary of State Henry Kissinger clearly stating to the Soviet ambassador at the time that Vietnam was the United States' top policy priority, the Soviets did not seem to understand at that moment that the bomber flights were a signal of U.S. willingness to escalate with nuclear weapons over the issue of Vietnam.

In spite of the amount of scholarly attention that nuclear compellence receives, it is notable that very little attention has been given to thinking about how states actually receive and interpret signals from an intelligence perspective. The case of Operation Giant Lance is demonstrative here. Former Soviet officials such as then ambassador to the United States Anatoly Dobrynin and then foreign minister Alexanderr Bessmertnykh have claimed in the past that they had received reports of the United States' nuclear alert, but very little information is available on what sort of information the Soviets had access to and how that information was presented to Soviet leadership.[7] As the relevant archives in Russia are closed, scholars such as Sagan and Suri tend to simply assume that the Soviets had enough information to correctly judge the scale of the threat, even if they could not link the threat to a specific U.S. objective. Sagan and Suri mention that the U.S. nuclear alert only involved bombers from certain bases on the West Coast of the United States.[8] U.S. Strategic Air Command did not use B-52 bombers in Guam, nor did they order a general dispersal of bomber forces. Despite the fact that U.S. Strategic Air Command apparently formulated the exercises with the express purpose to be noticed by Soviet intelligence, it is unclear if the Soviet Union was capable of observing many of those measures. During Giant Lance, the Soviet Union launched one reconnaissance satellite on October 11, which was then recovered on October 19.[9] It would have taken the Soviets some time to recover the satellite, develop and analyze the film, and communicate those findings to Soviet leadership. To give a similar example, it took interpreters five months to finish analyzing all the film imagery from the U-2 missions over Cuba during the Cuban Missile Crisis.[10] In the absence of reconnaissance imagery or other information sources detailing activity at U.S. bomber bases, the Soviet Union would have likely relied on their early-warning radar assets to track the increase in bomber flights and would not be able to judge the alert status of U.S. bomber bases. It is possible that Soviet leadership did not understand the shape and scale of the exercises until very late into October or months later.

An assessment of Operation Giant Lance demonstrates the importance of understanding precisely how, what, and when states know when another state is attempting to coerce. Assuming that a state has the capability to see the coercion attempt, when they actually cannot, at best makes the coercion attempt inert—and at worst could lead to miscalculation leading to conflict. The United

6 Scott D. Sagan and Jeremi Suri, "The Madman Nuclear Alert: Secrecy, Signaling, and Safety in October 1969," *International Security* 27, no. 4 (2003): 150–83, http://www.jstor.org/stable/4137607.

7 Ibid., 176.

8 Ibid., 150.

9 "Cosmos 247," NASA Space Science Data Coordinated Archive, NASA, https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=1968-088A.

10 Jeffrey Richardson, *Spying on the Bomb: American Nuclear Intelligence from Nazi Germany to Iran and North Korea* (New York: W. W. Norton & Co., September 2007), 138.

States has multiple regional adversaries that do not have a robust intelligence capability, which limits these adversaries' ability to not only interpret coercive signals but see them in the first place. Coercion is therefore difficult in many cases, as the signaling state needs to ensure that the signal is delivered in a way that the state being coerced can both see and understand. In other words, the signal must be visible. Visibility is a core tenet of the United States' current nuclear strategy and one of the core arguments for keeping the bomber leg of the U.S. nuclear triad. The 2018 Nuclear Posture Review identifies visibility as one of the key attributes of the nuclear force, defined as "the capability to display national will and capabilities as desired for signaling purposes throughout crisis and conflict."[11] Some states have less-visible nuclear forces, and this is generally on purpose. India, for example, does not publish the activities of its nuclear assets as the United States does, and India intentionally makes tracking its nuclear forces as difficult as possible.

One of the largest sources of information on foreign military activities is satellite imagery. Satellite imagery is a major piece of the United States' intelligence collection apparatus. It is also a capability that regional nuclear powers are actively pursuing, as North Korea has done with its launch of an imagery satellite in December 2022. They attempted to launch a second in early 2023, but the rocket failed after launch. Iran has a more developed military imaging program and has launched several imaging satellites into orbit, most recently the Khayyam satellite, which launched in August 2022. These capabilities in development by regional powers are at an interesting stage, as they are still in development and their current networks of satellites are very limited.

CASE STUDIES

The increased availability of commercial satellite imagery in the United States has allowed a small but growing number of satellite imagery analysts of various backgrounds to utilize these new tools in the analysis of a variety of current events, including Russia's 2022 invasion of Ukraine. Open-source satellite analysis has benefited from a proliferation of affordable satellite imagery paired with access to large audiences both on social media and through major traditional media outlets.[12] However, problems continue to plague how satellite imagery is handled by the media and on social media platforms.

First, very few organizations have access to a catalogue of satellite imagery large enough to be satisfactory to determine if military activity is unusual or not. Many amateur open-source analysts rely on what is available for free: this includes imagery made available on mapping services such as Google Earth and Apple Maps. The other major source is satellite imagery sources run by governments, which usually provide data for free. The Sentinel-1 constellation operated by the European Space Agency is one example, and Sentinel-1 data appears in one of the case studies below. While even these free datasets can provide analysts with large amounts of data about the area of interest, they generally do not provide the revisit rate necessary for deeper near-term analysis, nor are they responsive, as non-paying consumers generally do not have the ability to task satellites. This lack of robust and complete information creates problems when attempting to assess whether or not an event constitutes an anomaly.

The second problem is that many open-source analysts, especially the amateur ones that operate primarily on social media platforms, are highly responsive to current events. Few are actually area

11 U.S. Department of Defense, *2018 Nuclear Posture Review* (Washington, DC: Department of Defense, 2018), https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF.

12 Pranshu Verma, "The Rise of the Twitter Spies," *Washington Post*, March 23, 2022, https://www.washingtonpost.com/technology/2022/03/23/twitter-open-source-intelligence-ukraine/.

or subject-matter experts. Instead, they turn their attention to whatever the major story of the day is, which creates several problems. For example, they may not be well versed in the context of a new crisis and therefore must sometimes learn important concepts on the fly, such as critically important information about foreign military forces or how to use certain tools effectively.

An emerging state without robust satellite imagery capabilities may run into the same problems outlined in the case studies of this paper while trying to analyze the behavior of an adversary during a crisis. This makes open-source intelligence the perfect ground for examining how problems related to correctly analyzing satellite imagery might precisely lead to misunderstanding. The emergence of new tools or the lack of data may influence how a regional power interprets the intelligence they collect and relay to policymakers, which may have severe negative consequences on the crisis behavior of that state.

YOU NEED THE RIGHT TOOL: RUSSIA SYNTHETIC APERTURE RADAR CASE STUDY

The first case study demonstrates how having the right tool for the job and knowing how to use that tool is necessary to analyze certain objects. Not only does the resolution of satellite imagery matter, but the tool used to analyze such imagery also matters. Synthetic aperture radar (SAR) is a recent addition to many analysts' tool sets, and there have been many attempts to apply the technology to current events, some less competent than others. SAR imagery is actually generated by sending radar emissions down to Earth and measuring the time it takes for those emissions to return to the satellite. By doing this, it is possible to generate an image of the shape of a specific area, essentially by generating a very precise elevation map of the target. SAR is incredibly useful because it bypasses concerns about visible light conditions or cloud cover. As such, it fills in a large gap in a state or organization's ability to collect timely information about a certain target.

In the initial days of the Russian invasion of Ukraine, as Russian forces began advancing toward Kyiv, there was great demand for accurate information about the current location of Russian forces. Unfortunately, it was late February, and Ukraine is generally covered by clouds during that time period. Analysts began seeking out SAR data in an attempt to accurately track the movements of Russian forces. SAR is a new tool, and its utilization by amateur open-source analysts has been a relatively recent development, partly due to the fact that it has only recently been made available publicly via the European Space Agency's Sentinel-1 satellite. As with learning how to use any new tool, there is going to be a period of roughness as analysts learn how to use it and develop an understanding for the limits of its capabilities.

On February 21, a day before Russian forces actually crossed the border, a Twitter account with the username "@redpandaintel" tweeted an SAR image of the Ukrainian-Russian border near Chernobyl. The image, a low-resolution SAR image taken by the Sentinel-1 satellite system, showed a line of bright dots, signifying a strong radar return. The line of bright dots was annotated by redpandaintel with "convoy?" and speculated that the line represented a convoy of Russian military vehicles crossing into Belarus. Another Twitter account with over 10,000 followers, "@lobsterlarryliu," posted a similar image the same day.[13] The former tweet, since deleted, was met with high engagement and was retweeted by several of the bigger amateur open-source intelligence accounts on Twitter.[14]

13 Brecht Castel (@brechtcastel), "This message with hashtag #OSINT 'SAR data shows that there is a suspected movement of troops along the border between Russia and Ukraine' was NOT TRUE. We see a power line. Debunked by @BenDoBrown.," Twitter post, February 22, 2022, 9:58 p.m., https://twitter.com/brechtcastel/status/1497451064668295171. Original tweet since deleted.

14 Benjamin Strick (@BenDoBrown), "Good to verify using past dates what we see on satellite imagery to rule out in-

The image is a fantastic example of how intelligence analysis should not operate. Instead of an appropriate analysis that placed the SAR image in a much broader portfolio context of intelligence from different sources before drawing conclusions, the Twitter account seemingly did not consult any other source before claiming that Russian military vehicles were already moving into Ukraine. If the individual had consulted other data streams, including optical imagery, they would have certainly seen that the strong radar return that they had interpreted to be a convoy of military vehicles was actually a powerline.

The effect of this mishap was minimal. It was quite easy to check the optical imagery to disprove this information, and this particular information was not informing the actions of any government. But the implications of the incident are quite serious. In the current environment, new open-source and geospatial intelligence tools and applications for them appear frequently, such as using SAR for tasks such as identifying radar, using ionospheric data to track missile launches, and using multispectral and hyperspectral imagery for a whole host of tasks. The high demand for information in a crisis will almost certainly cause regional adversaries to turn toward some of these new tools, many of which are commercially available, and begin attempting to interpret the data immediately. Misinterpretation due to limited experience working with the data is a real possibility, and miscommunication internally is also a risk due to the sudden intake of many new sources of data. Sorting through all that data and communicating it to leadership coherently is a challenging task in itself.

During a crisis, these new sources of information will attract a large amount of attention as regional actors try to pull every lever at their disposal to evaluate the movement of U.S. military assets. With the intense demand for new data during crises, regional adversaries using new tools may come to invalid conclusions due to a combination of inexperience and a lack of due diligence. The sheer number of new tools presents some dangers, especially in organizations that are particularly susceptible to confirmation bias and politically motivated reasoning and conclusions.

YOU NEED THE RIGHT DATA: RUSSIAN AIR BASE STUDY

A common but erroneous belief is that the utility of satellite imagery for intelligence purposes is dependent on the resolution of the satellite image. A recent example of this is a South Korean government statement that a recovered North Korean imaging satellite launched in early 2023 was not fit for military reconnaissance activities. Yang Uk at the Asan Institute for Policy Studies was quoted in these reports as saying that "the resolution of the optical device loaded on the satellite was not suitable for military use."[15] History does not support these statements. Even low-resolution imagery has military utility, and early Landsat imagery produced a large degree of interest from foreign customers. China bought a ground imagery processing center for Landsat in 1979, for example, almost certainly for military purposes as part of China's attempts to keep track of Soviet military forces.[16] The Soviets had been so concerned about the sale of even low-resolution Landsat data to China that they attempted to link the issue directly with the Strategic Arms Limitation Talks (SALT) treaty and wanted the United States to commit to not sell any satellite imagery with a resolution better than 50 meters.[17]

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consistencies and false positives. This same bright line seen on @sentinel_hub imagery can be seen in past images, so I do not think it is a convoy.," Twitter post, February 22, 2022, 12:47 a.m., https://twitter.com/BenDoBrown/status/1496043913882259461. Original tweet since deleted.

15 Hyonhee Shin, "North Korea satellite had 'no military utility,' South Korea says," Reuters, July 5, 2023, https://www.reuters.com/world/asia-pacific/south-korea-says-retrieves-wreckage-north-korean-spy-satellite-2023-07-05/.

16 Parris H. Chang, "Peking's Strategy against Moscow," *Asian Affairs* 8, no. 3 (1981): 131–47, https://www.jstor.org/stable/30171819.

17 "Soviets Warn U.S. on Release of Reconnaissance Photos, Say It Will Affect SALT," Defense/Space Daily, January 12, 1979,

The rate at which a satellite, or a constellation of satellites, can visit a target is just as important, if not more so, than the resolution of the imagery. A high revisit rate that produces a large number of low-resolution images allows the analyst to determine specific changes in military activity that would not be detectable with a small number of higher-resolution images. A single high-resolution image might show how many aircraft an air base has, but it indicates nothing about how those military assets operate on a day-to-day basis. In order for an imagery analyst to do their job, they must first determine what is normal, so that they can determine what is unusual.

In the early months of Russia's invasion of Ukraine, an immense amount of media attention was directed at the current status of Russia's bomber forces, and satellite images of Russian nuclear-capable bombers repeatedly appeared on the websites of major media outlets. However, much of the actual analysis was somewhat questionable. The Russian bomber fleet regularly moves bombers from central air bases that store nuclear weapons to smaller air bases across the country. These deployments are a regular part of how the force operates, making it difficult to distinguish whether deployments are intended as signaling or simply represent regular operations. In late November 2022, Der Spiegel reported that satellite images showed an uptick in the number of nuclear-capable bombers deployed to one of Russia's largest airbases, Engels Air Base in Saratov Oblast.[18] While there had been an uptick in the number of bombers present, follow-on analysis that consulted imagery across a larger timescale concluded that the number of bombers at the facility was within the normal operating conditions of the air base.[19]

In another instance, a Norwegian news company, Faktisk, detected the presence of Russian bombers at an air base on the Kola Peninsula reportedly very close to the Norwegian border.[20] This observation prompted a great degree of media attention, with the sensationalist UK tabloid The Sun running with the particularly amusing headline "STRIKE FORCE: Putin Deploys 11 nuclear bombers 'just 20 miles' from Nato border as Russia warns of apocalyptic World War 3."[21] The movement prompted fears from some that Russia was preparing for nuclear strikes, possibly against targets in Ukraine, or using the deployment to threaten NATO with nuclear weapons.[22] But without longer-term analysis of the military movement, these observations are of limited utility. The bombers could have been repositioned for a routine exercise, not for any signaling or warfighting purpose. Without long-term tracking of Russian operating procedures, it was impossible to accurately determine the purpose of such movements.

In this case, a more granular review of the satellite imagery, combined with broader data about how Russian forces operate, can be used to determine the likeliness of a nuclear operation. The Russians

https://www.cia.gov/readingroom/document/cia-rdp87b01034r000700060001-2.

18 Alexander Epp, "Nachster russischer luftangriff steht offenbar kurz bevor" [The next Russian airstrike appears to be imminent], Der Spiegel, November 30, 2022, https://www.spiegel.de/ausland/ukraine-naechster-russischer-luftangriff-steht-offenbar-kurz-bevor-a-1b7ee87f-1c26-475c-81d2-3b516fa2f25e.

19 Joseph Trevithick and Sim Tack, "Surge In Russian Bombers At Air Base Not As Unusual as Reports Claim," The Warzone, December 1, 2022, https://www.thedrive.com/the-war-zone/surge-in-bombers-at-russian-base-not-as-ominous-as-media-claims.

20 Jan Gunnar Furuly and Kjell Persen, "Satellittbilder viser 11 strategiske bombefly 20 mil fra Norge" [Satellite images show 11 strategic bombers 20 miles from Norway], Faktisk, November 18, 2022, https://www.faktisk.no/artikler/z25lo/satellittbilder-viser-11-strategiske-bombefly-20-mil-fra-norge. The air base in question is actually 120 miles from the Norwegian border. It appears the author of the Faktisk piece confused Olenya Air Base, where the bombers were spotted, with a different air strip in a place called Titovka.

21 Aliki Kraterou, "STRIKE FORCE: Putin Deploys 11 Nuclear Bombers 'Just 20 Miles' from NATO Border as Russia Warns of Apocalyptic World War 3," *The Sun*, October 14, 2022, https://www.thesun.co.uk/news/20104178/putin-deploys-nuclear-capable-bombers-nato-border/.

22 Brendan Cole, "Fact Check: Did Russia Suddenly Move Nuclear Bombers to Norway Border?," Newsweek, October 14, 2022, https://www.newsweek.com/factcheck-russia-ukraine-norway-nuclear-bombers-nato-1751831.

have particular facilities for the storage and handling of nuclear weapons. The air base in question has none of these facilities, making it somewhat unlikely that it would be chosen for a nuclear deployment, especially given its proximity to a NATO member state. More recent analysis of satellite imagery has revealed that the Russians have in recent months turned the air base into a facility that appears to indefinitely host bombers for striking targets in Ukraine with conventional munitions.[23]

The alarm from European media outlets over the matter demonstrates the importance of having a large archive or imagery of certain locations and certain patterns of activity, such that an accurate determination of the purpose of the movement itself can be reached. Movement of particular aircraft to particular facilities is not in itself unusual and must be situated in the broader context of how those militaries generally operate their forces. Such movements must also be rooted in background knowledge of a military's infrastructure signatures, so that analysts can determine the munition type via the supporting facilities. If possible, determining whether or not an aircraft is carrying a nuclear or conventional payload would be of critical importance during a crisis. If a regional actor lacks this data and simply sees a new deployment of nuclear-capable forces in a place they have not seen such forces deployed before, they may assume that the activity that appears unusual to them may be a sign that the foreign military force is likely to do something unprecedented.

POLICY IMPLICATIONS

It is important that policymakers and military planners are aware of the problems presented by limited access to intelligence sources such as satellite imagery. The lack of access is not itself a problem, nor is having robust access to intelligence. However, limited access to intelligence data means that leadership in these small regional powers are going to have to make important decisions based on incomplete data. This opens the possibility that they will simply fill in the gaps in their understanding with what they expect to see. Jeffrey Lewis has a useful counterfactual demonstrating the problem. In his fictional book, *The 2020 Commission Report on the North Korean Nuclear Attacks Against the U.S.: A Speculative Novel*, a limited strike on North Korean command nodes is misinterpreted by the North Koreans as the opening salvo of a decapitation effort, triggering a North Korean nuclear response.[24] This misunderstanding is informed from previous U.S. military action. In the opening days of the 2003 U.S. invasion of Iraq, one of the first targets hit by the United States was a compound outside of Baghdad called Dora Farms, frequented by Saddam Hussein. U.S. intelligence believed that Saddam was at the compound, and President George W. Bush ordered an airstrike in an attempt to decapitate Iraqi leadership. Combined with explicit South Korean planning to conduct decapitation strikes, it is likely that the North Koreans expect that U.S. and South Korean aggression would begin with such a strike. Because of this, the North Koreans would heavily examine any U.S. military movement during a crisis for signs of possible preparation for a decapitation strike. Combined with North Korea's limited, but not nonexistent, ISR capability, North Korean analysts and leaders could look at the limited information they have access to and see the worst-case scenario.

This risk will probably lessen if North Korea builds up a robust intelligence capability. Once North Korea has sufficient access to satellite imagery and other robust information sources, many of the concerns presented here will be less relevant. North Korea will have access to enough data to

23 Review of satellite imagery from Planet Labs and Maxar reveals that a number of bombers have been present at Olenya Airbase since roughly December 2022. Several new facilities have been built at the airbase that point to the long-term placement and maintenance of bomber aircraft at this facility.

24 Jeffrey Lewis, *The 2020 Commission Report on the North Korean Nuclear Attacks against the U.S.: A Speculative Novel* (Boston: Houghton Mifflin Harcourt, 2018).

gain a clear picture of how the U.S. military operates and what specific military movements mean. This assumes that North Korea's intelligence organizations are intellectually free and relatively independent enough to come to the correct conclusions. The United States' decision to invade Iraq based largely on false intelligence that the Saddam regime had an active weapons of mass destruction (WMD) program is one such example where bureaucratic and ideological drivers won out over more careful analysis.[25]

Obviously, states seek to possess perfect information about an adversary's military capabilities and operational patterns in order to develop expectations of how military assets will be used on the battlefield. It is natural that some states would be hesitant to reveal such operational patterns to an enemy. However, the creation and maintenance of those expectations is key to effective signaling and ensuring that signals are not incorrectly identified as actual war preparations. This played out in the Russian case study, as news organizations reacted disproportionately to minor movements of nuclear-capable Russian assets. Because developing a clear picture of how certain states will employ their military assets in a real war is critical to minimizing miscommunication, increasing communication between the political and military organs of the United States and other states should be a priority. These communications can be helpful in ensuring that each side has a picture of what states perceive as threats and how they might signal the use of force. In the case of the United States and Russia, military dialogues were halted in 2016, and given that current relations are extremely fraught over the war in Ukraine, such dialogue is unlikely to be restarted any time in the near future. The story is similar with the United States' other probable adversaries—North Korea, Iran, and China. Even under the extraordinary circumstances with Russia given the war in Ukraine, efforts should be made to restart military-to-military dialogues as a way of ensuring escalation control during a crisis.

The relationship between signal assessment and technological capabilities also has implications for U.S. state behavior during a crisis. With the advent of laser dazzlers—weapons capable of temporarily blinding overhead imagery satellites—states could obscure their own military movements during a crisis, or a state could begin using such systems regularly to stop an adversary from observing regular patterns of operation and particular sites. The employment of such systems, while possibly a signal in and of themselves, would complicate another state's ability to properly assess whether or not a military movement is signaling or preparing for an impending attack. As a result, the United States should keep in mind that developing such systems, for example, anti-satellite and cyber capabilities capable of blinding an enemy, would possibly trigger an adversary's deep fear of a U.S. first strike and lead to a disproportionate response.

Lastly, the United States should do nothing to attempt to interdict or interfere with efforts by regional adversaries to acquire commercial satellite imagery. North Korea has shown foreign commercial satellite imagery in propaganda before. It is likely that they have access to significant quantities of foreign commercial satellite imagery for surveilling U.S. and South Korean military forces. This should not only be allowed but actively encouraged, so that North Korea has access to multiple information streams that will allow them to analyze U.S. military movements and more accurately assess the level of threat.

25 Both of these drivers were critical to the U.S. intelligence community's failure to correctly determine the scope and scale of Iraq's WMD program. Lacking hard information, the intelligence community relied on their preexisting notions of how Iraq would behave, not how they were actually behaving, partly to satisfy political incentives. Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction, *Report to the President of the United States* (Washington, DC: U.S. Government Publishing Office,March 2005), https://www.govinfo.gov/content/pkg/GPO-WMD/pdf/GPO-WMD.pdf.

The United States has never faced a situation where adversary intelligence was expected to operate effectively instantaneously across an incredibly information-dense environment. Its actions during a crisis carry a chance of misinterpretation, and these misinterpretations would have extreme consequences due to the brief travel time and extreme accuracy of modern munitions—a moment of hesitation on the part of North Korean leadership could be enough time for the United States to disable or destroy a large part of North Korea's nuclear arsenal. Because of this, policymakers in the United States should be very aware of the constraints their adversaries are fighting under and how that will affect their behavior.

New Generation, New Understandings

The Role of TikTok and Other Social Media in Nuclear Escalation

By Mari Faines[1]

INTRODUCTION

When global crises occur, policy positions in the United States tend to reflect the views of a small portion of the population. For example, in the wake of Russia's invasion of Ukraine, there was a groundswell of conversation in U.S. popular media, academia, and policy communities alike about the role of nuclear weapons and their impact on the crisis and the globe at large. Unfortunately, by engaging in these conversations largely through traditional avenues for academic discussion, such dialogues may miss insights and misrepresent perspectives of populations who do not engage in the use of these traditional channels.

To give an example, while there has been much discussion of the gravity of the potential for escalation by Vladimir Putin in the wake of the invasion of Ukraine in the traditional media and among older generations, some members of Generation Z (Gen Z) have meanwhile been scaring their parents and others into believing that a nuclear war has begun as part of a prominent trend of pranks on social media platforms, particularly TikTok. The flippancy and lack of understanding of the severity of potential risk is an example of the disconnect between some individuals in Gen Z and older generations; it also offers a larger commentary on the lack of nuclear education and meaningful attempts to make connections between generations.

1 Mari Faines is a nuclear non-proliferation advocate experienced in strategic communications and policy. The views expressed in this paper are her own and do not necessarily reflect the views of her employers.

Nuclear weapons are no laughing matter. Therefore, the role of social media in public perceptions of the nuclear weapons complex must be better understood, particularly as it applies to one of today's most active generations. Thus, this essay seeks to explain the role of social media, specifically TikTok, in certain public perceptions around nuclear weapons and its potential impact on advocacy, education, and policymaking.

THE INTERGENERATIONAL IMPACTS OF SOCIAL MEDIA IN CRISES

On February 24, 2022, Vladimir Putin initiated a full-fledged invasion of Ukraine. It was an unprecedented move, changing the geopolitical landscape across the globe. This war was set on the backdrop of an already tumultuous time, as the world was resurfacing after a global pandemic, multiple political regime changes, and ongoing intersectional issues related to multiple global, existential challenges such as climate change and ongoing social and racial injustice. Putin's invasion and subsequent posturing about the use of nuclear weapons enforced the theory that "escalation is ultimately a political activity."[2] The role of escalation in modern discourse has been heightened further by the risk of continued testing of nuclear-related capabilities by powers such as North Korea. Moreover, amid the dissipation of international treaties such as the Joint Comprehensive Plan of Action (JCPOA) with Iran and later the New START Treaty with Russia, the potential for nuclear escalation was front of mind.

In this time of turmoil, many among older generations turned immediately to memories of the Cold War and the Cuban Missile Crisis. Younger generations could reference fearful moments of the recent past, including threats from North Korea, which in turn led the posturing from former president Donald Trump, as he fumbled through diplomacy, including nuclear diplomacy, from behind his Twitter keyboard. Through such incidents, it became evident that younger generations who gathered their news from social media platforms were influenced by the rapid pace of the news cycle. While this may permit instant notification of a news story, deliver useful information, or even evoke raw emotions, the rapid life cycle of news stories can minimize the importance of certain stories, lasting only as long as the user sees a post on a news feed.

The juxtaposition of how these different generations understand news may help explain differing generations' views on the severity of nuclear escalation. Generations who lived through the Cold War or the Cuban Missile Crisis have memories of the fear and trauma caused by the potential for an impending nuclear war. These generations functionally understand the role of "experts" and traditional media and their role in the discussion and explanation of the ramifications of the potential threat of nuclear war. In contrast, younger generations, including Gen Z, are only privy to nuclear-related accidents such the Hawaiian false missile alert in 2018 or the continued "nuclear trolling" on social media by some previous world leaders. The flippancy of the relationship with such rhetoric, especially on social media, likely has had an impact on younger generations' understanding of the gravity and role of these weapons. Comparing this carefree attitude about nuclear weapons with Gen Z's acute understanding of other existential issues, including climate change, racial and social injustice, public health, or economic disparities, one might question why some members of Gen Z may react with humor to this topic, for example, suggesting that these reactions amount to a coping mechanism for other more proximate issues in their life.

2 Vipin Narang and Heather Williams, "Thermonuclear Twitter?" in *The Fragile Balance of Terror: Deterrence in the New Nuclear Age* (Ithica, NY: Cornell University Press, 2022), 66.

In any case, the role of social media has been studied both inside and outside of conflict, raising questions around misinformation and disinformation, its impact on decision making, and the socio-emotional and psychological ramifications of its use.[3] This paper approaches many of these questions, acknowledging that TikTok has now added a new layer to the already complex relationship between generations and, more significantly, a new layer of complexity to the role of social media in the nuclear threat.

UNPACKED: MISINFORMATION AND DISINFORMATION

SOCIAL MEDIA

Social media platforms are not a monolith. Between different types of content and different audiences, there are nuances to how social media has an impact on both individual and collective communities. As a result, when analyzing social media as a tool for policy or political purposes, these nuances must be acknowledged. When reflecting on the role of social media during times of crisis, one must continue to acknowledge these differences, recognizing that "different social media platforms can work at cross-purposes against each other in crises."[4]

The first point of recognition is that there are generally preexisting political and ideological divides and characteristics that run throughout public discourse.[5] These divides are often reimagined and reinvigorated across social media during times of crisis. As outlined by Vipin Narang and Heather Williams in their chapter "Thermonuclear Twitter?," in *The Fragile Balance of Terror*, there are two different types of platforms for social media: open and closed.[6] X, formerly known as Twitter, is an example of an open social media platform; this platform and others like it are "often an opportunity to engage with strangers."[7] In times of crisis, they can "assemble and disseminate accurate information more broadly."[8] In contrast, closed social media platforms such as WhatsApp are used as forms of communication to engage with people we "know and trust."[9] Closed platforms allow greater opportunity to reinforce false narratives and incorrect information during a crisis, leading to "clusters that reinforce preexisting beliefs and opinions rather than seeking accurate information."[10] These nuances are incredibly important because while there is an opportunity for open social media platforms such as X and TikTok to disseminate mis- and disinformation, there is also an opportunity for them to course correct over time through public conversation and engagement.

MISINFORMATION AND DISINFORMATION IN REAL TIME

While mis- and disinformation can be corrected over time on open platforms, one cannot diminish the immediate harm caused in real time.[11] When a crisis occurs, activity on social media flourishes. In July 2020, the Pew Research Center conducted a study analyzing the U.S. public's views of social media, noting that "about two-thirds of Americans (64%) say social media have a mostly negative

3 Ibid., 67.
4 Ibid., 65.
5 Peter Hayes, "Social Media Arrives on the Nuclear Stage," Toda Peace Institute, Policy Brief no. 66, November 2019, https://toda.org/assets/files/resources/policy-briefs/t-pb-66_peter-hayes_social-media-arrives-on-the-nuclear-stage.pdf.
6 Narang and Williams, "Thermonuclear Twitter?," 89.
7 Ibid., 64.
8 Ibid., 64.
9 Ibid., 64.
10 Ibid., 64.
11 "False information that is deliberately often covertly spread, to influence public opinion or obscure the truth." "Disinformation," Merriam-Webster, last updated December 4, 2023, https://www.merriam-webster.com/dictionary/disinformation; and "Misinformation," Merriam-Webster, last updated December 3, 2023, https://www.merriam-webster.com/dictionary/misinformation.

effect on the way things are in the country today."[12] This study cited a rise in misinformation, disinformation, and harassment as key indicators for social media's negative and traumatic impact on users. The study likewise acknowledged concerns about the lack of expert content and the susceptibility of individuals to "believing everything they see or read—or not being sure about what to believe."[13] The inability of the public to discern between real or fake news in turn allows for factually incorrect information to be manipulated, particularly in times of crisis or high tension, to create political effect.[14] While some might say that traditional news media, such as television, may be able to disseminate equal amounts of mis- and disinformation, the particular demographics of social media allow for "cross-pollinating (or cross-polluting)" that uniquely allows for the rapid spread of factually incorrect information in times of tension.[15] This quick dissemination of incorrect information has an immediate impact. While there is an opportunity to course correct over time, these platforms are often used to propagate ideas, which in the context of the nuclear threat could potentially negatively impact a crisis.

EMOTIONAL TRAUMA

The role of mis- and disinformation is not just damaging to the trust deficit in politics or during crises. It is part of the psychology of social media and relies on exacerbating mental and emotional trauma in individuals, especially during times of crisis. As part of what the European Commission identifies as an "attention economy," social media creates incentives for individuals to do whatever it takes to garner attention online, regardless of the potentially negative effects on others.[16] This allows for polarizing discourse on open platforms such as Twitter, Reddit, Facebook, and now TikTok, where "algorithms prioritise content that has, or is expected to have, a high level of engagement."[17] This causes an influx of polarizing and controversial content. The paridigm of carelessness around nuclear use that permeates certain Gen Z TikTok pranks, is a prime example of a need for performativity even at the cost of others' well-being, and potentially during times of crisis.

ANALYSIS

TIKTOK

The field of nuclear weapons policy may still lack an abundance of literature on the role of social media and its impact on the nuclear threat. Some experts have worked on the role of major social media networks in the nuclear field, including X, Facebook, and WhatsApp, but there is a new major social media network on the scene, TikTok, and there is still much to be learned about its role in relation to the nuclear weapons complex.

TikTok represents a unique platform; it was originally designed to produce short-form videos lasting 30 to 60 seconds, though they can be as long as 10 minutes today. Its target demographic has been younger generations, specifically younger millennials and Gen Z. The app is most used by people

12 Brooke Auxier, "64% of Americans Say Social Media Have a Mostly Negative Effect on the Way Things Are Going in the U.S. Today," Pew Research Center, October 15, 2020, https://www.pewresearch.org/short-reads/2020/10/15/64-of-americans-say-social-media-have-a-mostly-negative-effect-on-the-way-things-are-going-in-the-u-s-today/.
13 Ibid.
14 Hayes, "Social Media Arrives on the Nuclear Stage."
15 Narang and Williams, "Thermonuclear Twitter?," 63–89.
16 "Social Media Influences Our Political Behaviour and Puts Pressure on Our Democracies, New Report Finds," EU Science Hub, Joint Research Centre, October 27, 2020, https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/social-media-influences-our-political-behaviour-and-puts-pressure-our-democracies-new-report-finds-2020-10-27_en.
17 Ibid.

ages 13 to 29; in the United States, "32.5% of users are aged 10-19, and 29.5% are aged 20-29."[18] This tracks with the current understanding of the platform at a global level, where the assumption is that most users are "pre-teen," indicating that Gen Z is the primary age group. TikTok has carved out its niche because the content is presented to an individual based on an algorithm that is specifically tailored to their individual preferences based on their previously liked content.[19] The app has been presented as the social media platform of the future, known for not only its dancing videos but its ability to disseminate diverse perspectives across political, racial, socio-economic, and international boundaries. It has been touted as the soundboard for the younger generation, creating a distinctive and unique culture, despite its many similarities to previous iterations of social media.[20] The broadness of topics, personal and political expression, and the open nature of the platform allows for misinformation to spread. TikTok creates opportunities to discuss some of the world's most critical threats, including climate change, social and racial injustice, or public health, but it also creates gaps for other threats, such as the threat of nuclear war, that require the insights of a multitude of generations as well as other forms of diversity.

THE PRANK

Intergenerational misunderstanding as it pertains to the gravity of the threat of nuclear escalation is exemplified in the recent "nuclear missile prank" on TikTok. As of June 2023, when searching #NuclearMissilePrank on TikTok, one will find that this hashtag and its videos have been viewed over 11 million times.[21] Likewise, its collaborative hashtags "#Nuclearattackprank" and "#Nucleramissleattack" have over 4 million views combined.[22] The prank consists of the user recording a video of a subject, typically of someone of an older generation, reacting to a screen-cast video from YouTube meant to simulate public warning systems reacting to an impending nuclear attack.[23] The person recording the video then watches and films the subject's reaction to finding out that a nuclear weapon has been launched on major U.S. cities, often laughing at the very real and often traumatic reactions. The most important throughline among the videos of these pranks is the very real fear from people who remember living through crises—and the very carefree nature of those who grew up in an era when the president tweeted out potentially catastrophic, though generally empty, threats.

THE POTENTIAL RISKS

There are a multitude of reasons why this prank could be unnecessarily harmful and escalatory in the current state of nuclear affairs, but this paper will focus on two: the potential for miscalculation and escalation of nuclear risk and the potential for heightened emotional trauma.

As previously stated, the world currently faces a heightened potential for nuclear escalation. Whether due to Putin's posturing in the wake of Russia's invasion of Ukraine, North Korea's continued testing of nuclear-related capabilities, or the fall of the JCPOA, the risk of nuclear escalation is particularly high. Early warning signs and the increased reliance on social media for news can cause heightened feelings

18 Darragh McCashin and Colette M. Murphy, "Using TikTok for Public and Youth Mental Health – a Systematic Review and Content Analysis," *Clinical Child Psychology and Psychiatry* 28, no. 1 (June 2022), 280, https://doi.org/10.1177/13591045221106608.

19 Ibid., 280.

20 John Herrman, "TikTok Is Shaping Politics. But How?," *New York Times*, June 28, 2020, https://www.nytimes.com/2020/06/28/style/tiktok-teen-politics-gen-z.html.

21 Author's search for "NuclearMissilePrank" on TikTok Search, June 2023.

22 Ibid.

23 "Real-Time U.S. EAS Nuclear Attack," YouTube video, posted by YP, March 8, 2022, 11:16, https://www.youtube.com/watch?v=aIcUSd3nkJE&t=116s.

of tension and increase the potential risk for escalation. When it comes to the escalation web, "the nature of the crisis also matters," and "political context and stakes affect the outcome of conflict."[24]

The Trump presidency reinforced that there is a role for social media in the potential for escalation risk, with leaders using their keyboards to respond to "threats" that they see online. Right before the 2018 Hawaii false missile alert, then president Trump tweeted: "North Korean Leader Kim Jong Un just stated that the 'Nuclear Button is on his desk at all times.' Will someone from his depleted and food-starved regime please inform him that I too have a Nuclear Button, but it is a much bigger & more powerful one than his, and my Button works!"[25] While there were no escalatory reactions due to the checks and balances in place across systems, it still raises questions. If any other, less risk-tolerant nuclear-armed leader was to log into TikTok or YouTube and see the videos of North Korea's test, would they take it as a threat? Would another leader see it as a legitimate reason to escalate?

While some may argue that 20 million views is relatively small, and poses very little possibility for escalation risk, the fact that 20 million people have viewed these videos and continue to share them daily can plant seeds for political propaganda. If weaponized against primed and easily influenced populations, this has the potential to create widespread panic and heightened risk of miscalculation of threat. Theories from previous scholars have shown the potential impacts that social media can have as an important source of information, but also acknowledge the potential for mis- and disinformation to spread rapidly ahead of verified information. This not only leaves the door open for escalation risk, as previously discussed, but also speaks to a larger potential for emotional trauma.

A key feature of the TikTok prank is the emotional trauma caused to individuals who have lived through at least some form of nuclear crisis. Whether those who were being pranked lived through the Cold War, Cuban Missile Crisis, or even most recently the Hawaiian false missile alert, there are clear and triggering memories associated with a warning about the potential threat of a nuclear war. Throughout the videos, you hear older adults trying to remember what they learned during the duck-and-cover drills of the Cold War, calling family members as they recognized their homes no longer have "bomb shelters," or making decisions about "running or staying" as they fearfully recognized an impending nuclear war. Their words echoed reactions in Hawaii, such as those of Cynthia Lazaroff, who experienced the 2018 alarm crisis and wrote about the "terrified people driving 90-to-100 miles per hour" to get final minutes with their loved ones, or her own fear of not seeing her daughters again.[26] Social media can be great, for example, as it broke the story that the Hawaiian crisis was "just a test" before traditional media, but due to its attention-seeking nature, it can also be a place where people host pranks to intentionally inflict emotional trauma on others for the sake of views.

While one might argue that the role of emotional trauma has no place in the conversation about nuclear risk, this is inherently false. The impact that these weapons have on people are real. The emotional trauma and fear of the target and the lack of understanding of an issue by the prankster are both indicators of how individuals view the world around them and the role of emotions in the nuclear complex. When assessing the role of TikTok in nuclear escalation, the role of emotional understanding must be considered to recognize what theories, videos, and ideologies are likely to do well and "trend" among younger demographics. These factors impact the choices that individuals make, their perception of reality, and what policy choices they may support in the future. The same

24 Narang and Williams, "Thermonuclear Twitter?," 72.
25 Ibid., 83.
26 Cynthia Lazaroff, "Dawn of a New Armageddon," Bulletin of the Atomic Scientists, August 6, 2018, https://thebulletin.org/2018/08/dawn-of-a-new-armageddon/.

individuals engaging in these pranks and this discourse on TikTok are now or will soon be the same people voting for elected officials who have the ability to shape policy that will impact the risk of potential nuclear conflict.[27] If scholars are truly going to understand the next generation's opinions of nuclear risk, especially in an effort to create a greater understanding of the gravity of nuclear warfare, they must first spend time understanding the world in which these demographics exist.

RECOMMENDATIONS

The role of social media among younger generations, especially Gen Z, is enormous and is not going to abate anytime soon. As is often colloquially stated, but sprinked with nodes of truth, when Gen Z has a question, they do not go directly to Google, they go to TikTok.[28] Research from the Pew Research Center confirms that people under 30 are the most likely demographic to believe that social media has positive impacts on society.[29] That means that there needs to be increasing research, care, and attention paid to the role of social media, particularly TikTok, as a medium for engaging on nuclear issues. There need to be more safeguards in place against mis- and disinformation to encourage a "'truth infrastructure' trusted by users . . . to provide legitimate and authoritative review of what's real versus what is fake."[30]

There also needs to be greater engagement on these platforms from government, academic, think tank, and advocacy organizations to meet younger generations where they are. Most importantly, such actors need to acknowledge that Gen Z is not ignorant of most existential issues. They understand the impact of grave issues such as climate change and social and racial injustice, which pose an existential threat, and that many such issues are interlinked. But there are also gaps and opportunities for certain demographics to continue to learn about issues including nuclear risk; therefore, greater attention must be paid to reach these audiences. That goal is as much about educational opportunities as it is about risk reduction related to miscalculations caused by potential social media mis- and disinformation. There are many experts (young and old), advocacy organizations, and academic institutions here doing the work needed to reach these audiences on their platforms, but more can and must be done to generate greater risk reduction, education, and overall safety on platforms such as TikTok.

27 Erik Lin-Greenberg, "Soldiers, Pollsters, and International Crises: Public Opinion and the Military's Advice on the Use of Force," *Foreign Policy Analysis* 17, no. 3 (2021), https://doi.org/10.1093/fpa/orab009.

28 "Gen Z Is Bypassing Google for TikTok as a Search Engine," ABC News, August 17, 2022, https://abcnews.go.com/Technology/gen-bypassing-google-tiktok-search-engine/story?id=88493981.

29 Brooke Auxier, "64% of Americans Say Social Media Have a Mostly Negative Effect on the Way Things Are Going in the U.S. Today," Pew Research Center, October 15, 2020, https://www.pewresearch.org/short-reads/2020/10/15/64-of-americans-say-social-media-have-a-mostly-negative-effect-on-the-way-things-are-going-in-the-u-s-today/.

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